SEP 23 1944

PAPER TRADE JOURNAL

SEPTEMBER 14, 1944

Established 1886

Approaching Triumph

"The victory of endurance born."
WILLIAM CULLEN BRYANT

Now that the eventual triumph of the Allied Nations is practically assured, though united efforts must remain unslackened, tribute is in order for the quality of endurance shown everywhere:

First and foremost, by the fighting men and women on land and sea and in the air; then by all those who have produced mightily (including the Pulp and Paper Industry), often under sharply handicapping conditions; and finally by everyone on the home front who has endured patiently the multitude of difficulties that a global war necessarily entails.

There is glory enough for all—and it is good to know that the end seems at last in sight.

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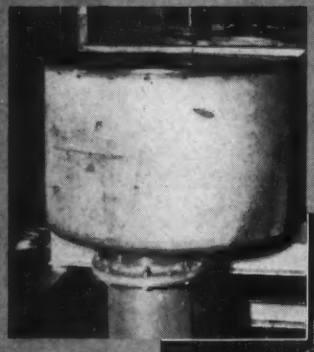
Sometimes we get "awful fed up" with the things we read and hear about post-war. It seems downright unpatriotic when we all know there is a lot of tough fighting ahead. . . . But then, we think our military and naval officers must have planned far ahead before the landing at Guadalcanal and the invasion of North Africa. And that even before these offensive actions were started, they must have planned what they would do next and next after each conquest, so that they would not lose precious time. Since the leaders of our fighting forces are planning ahead, it seems only right that paper mill management and machinery manufacturers should plan ahead, too, so that no precious time will be lost in getting new, much-needed machinery after our Government says "Go Ahead." Careful planning of mill improvements takes time. We're ready to work with you now. . . . Downingtown Manufacturing Company, Downingtown, Pennsylvania.



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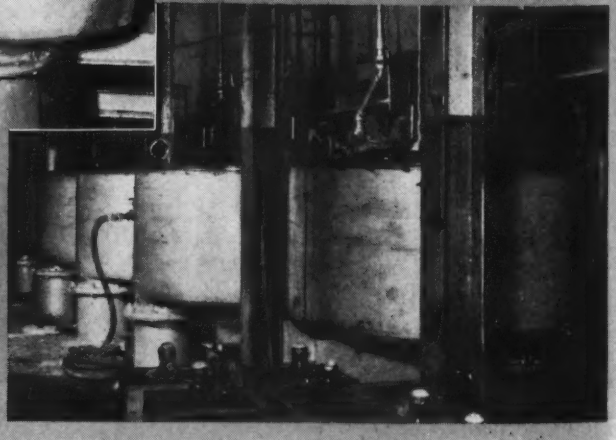

PAPER TRADE JOURNAL

Title Reg. U. S. Pat. Off.
Established 1872

Volume 119 Number 11

Published every Thursday by Lockwood Trade Journal Co., Inc.
Executive and Editorial Offices:
15 W. 47th St., New York 19, New York, U. S. A.
Tel. BRyant 9-0860 New York 19, N. Y.

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All of 15 W. 47th St.

Western Representative:
H. K. VINTON
123 West Madison St., Chicago, Ill.

Subscriptions: (Payable in advance) By the year $4.00; Single Copy 10 cents.
Postage Extra: To Canada $2.00; To Other Foreign Countries $3.50.
Member Audit Bureau of Circulations

PAPER *established Feb. 17, 1899, combined with* PAPER TRADE JOURNAL *Nov. 16, 1899.* PAPER *established Sept. 21, 1910, combined with* PAPER TRADE JOURNAL, *Feb. 19, 1925.*

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PAPER TRADE JOURNAL *is entered as Second Class matter at the Post Office at East Stroudsburg, Pa., under Act of Congress of March 3, 1879. Publication Office of Lockwood Trade Journal Co., Inc., 34 N. Crystal St., East Stroudsburg, Pa. Printed in U. S. A.*
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Vol. 119, No. 11

PAPER TRADE JOURNAL

Title Reg. U. S. Pat. Off.

September 14, 1944

Technical Association of the Pulp and Paper Industry in War and Peace

By R. G. Macdonald, Secretary-Treasurer, Technical Association

War calls to mind thoughts of munitions, planes, tanks, and explosives and the glamour of conflict. Behind this is the civilian economy geared up to intensive production, first, of the implements of war and the materials needed to sustain troops in the field and, second, the maintenance of the civilian economy to the extent possible when military requirements have been fulfilled.

The pulp and paper industry as a part of the service of supply is like most other industries attempting to serve both of these functions. The statistics relating to its accomplishments have been made known in the trade papers and government reports. The development of the industry's products to meet the military and civilian needs have also had wide publicity. The story of the substitution of paper for other materials has been the report of a great accomplishment. The part played by individuals who have worked closely with the War and Navy Departments, the War Production Board, the Office of Price Administration and other wartime services has been extensive. The various trade associations of the industry have worked long and hard to integrate the efforts of the individual companies to best serve the Nation's needs.

The Technical Association (TAPPI) like the other organizations, was called on primarily to extend the influence of the temporary organizations set up by the Givernment to accomplish its objectives. In general, the government agencies have preferred to deal with industry committees to accomplish limited tasks. Although the associations in general were not called on to perform these tasks as entities, they were largely the medium through which the task groups were organized; and they gathered much of the information that was needed by these groups.

VANCE W. EDWARDES
President, Technical Association of the Pulp and Paper Industry.

TAPPI was one of the few organizations specifically requested to do a necessary job. This request dealt with its special ability to develop reliable means of evaluating paper properties and resulted in the establishment of methods for determining the brightness of pulp and paper and the water vapor permeability of paper. The latter request was received directly from the Office of the Quartermaster General. Requests for the establishment of standard container testing methods has resulted in an extensive program to attain this end and is successfully in progress. The Technical Association's office has been a clearing house for a steady flow of inquiries for technical information and for technical personnel to handle specific problems.

The demand for the Standard Testing Methods of the Technical Association has resulted in the distribution of Standard Manuals to a very large number of posts in the Navy, Quartermaster Corps, Engineer Corps, Ordnance Department, and the Army Air Forces. The many years and great effort of the TAPPI testing committees has been rewarded in part by the recognition by the armed services of these methods, many of which have been *specifically designated* in the materials procurement specifications, an unusual practice. It is gratifying to note that the association was ready when they needed to meet this situation and thereby saved the time that otherwise would have to be used by these specification branches of the services in formulat-

ing them. Emergency methods developed under time pressure would be not as reliable as those developed over the years by TAPPI under conditions that permitted checking and revision to arrive at the best known methods for determining the physical and chemical characteristics of pulp, paper and paperboard.

Development of New Paper Products

During 1942 and 1943 the association contributed greatly toward a full understanding and an inspiration on the part of the pulp, paper, paperboard, and container industries relative to the development of new paper products. In September 1942 at Boston the association anticipated the great container problem with its exhibit of papers and paper products. The industry was groping at the time and needed this meeting and exhibit to point the way to the desired objective. At the time the problem dealt with the need of creating papers that could replace the metal can, rubber, textiles, and other materials. Even though the paper products were relatively crude they were sensational, particularly the waterproof, the water vaporproof, and greaseproof products. Several new containers such as those for holding paint were shown for the first time. Many of the products on display at the exhibit were considered to be remarkable but few would have stood up well in the specifications brought out within the following year.

The association was on the job early in assisting the Quartermaster. When the association was first called upon to assist the Chicago Quartermaster Depot, the latter was an extremely small organization, quite different from the one that exists today with its great organization of technical specialists. The problem of packaging to meet severe use conditions was just beginning to be realized. The statement of the problem itself was just being formulated and methods of testing needed to be known. The call by the TAPPI Secretary to the leading technical men of the paper industry in the packaging products field met with unanimous response and the large group that met at the Stevens Hotel in Chicago to assist Major Hermann was one of the best task groups ever brought together in the industry. The results have spoken well for themselves.

GUNNAR W. E. NICHOLSON
Vice President

R. G. MACDONALD
Secretary-Treasurer

The Boston meeting was featured by the presence of Major Melson of the Chicago Quartermaster Depot who further outlined the progress made and the problems existing in packaging for overseas shipment. It further served as a much needed forum for the exchange of information on the part of the mill representatives who were engaged in making the new paper and paperboard products that were needed. The Annual meeting held in New York in February, 1943, was a reflection of the great progress being made and the presence of Army officers and civilian contractors from other branches of the services indicated the recognition of the association as the fountainhead of knowledge and research on paper problems. The exhibit at New York, in which the War Department officially participated, was a much larger one than that held at Boston and showed the great advance that had been made in five months. Here many more new types of containers and laminations were shown to the public for the first time and the exhibit of the Quartermaster was the forerunner of the great Army and Navy show to be presented later in the year at Chicago.

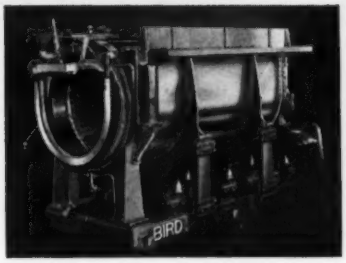
An Outstanding Contribution

The culmination of the industry's contribution to the war effort was the Army and Navy Requirements Conference at the Palmer House in Chicago in September, 1943. Here twenty thousand square feet of exhibit space was devoted at the expense of the Technical Association to an exhibit of all branches of the Army Service Forces, the Army Air Forces and to the procurement Bureaus of the Navy. Each branch of the services was represented by one or more technical specialists who were on hand to explain in great detail their packaging problems. The physical aspects of the exhibits and motion picture theater were outstandingly glamorous and were the production of the Exhibits Section of the War Department and the Bureau of Supplies and Accounts of the Navy Department.

The meeting itself with its great registration of more than 4200 members, Army and Navy packaging contractors was something that will long be remembered by those who attended. Starting with Naval Station Band and Choir and the radio addresses of Rear Admiral Everett G. Morsell and Brigadier

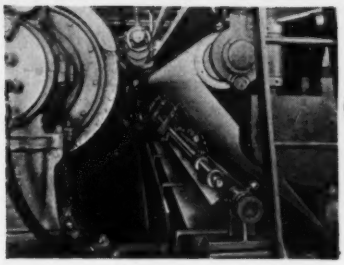
Members of the Technical Association *Associate* BIRD MACHINERY *with* These Essential Points in the Papermaking Process

Paper Screening



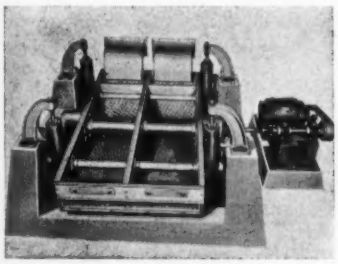
The BIRD SCREEN is standard throughout the industry. In addition to guarding paper quality and uniformity it makes possible sustained paper machine operation at maximum speed.

Continuous Felt Conditioning



The VICKERY FELT CONDITIONER keeps press felts clean and open without mid-week paper machine shut-downs. It assures improved paper finish and maximum water removal at the presses.

Pulp Screening

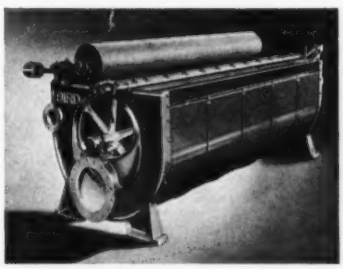


The JONSSON SCREEN turns out more and cleaner pulp with minimum loss of good fibres in the tailings at lowest cost per ton. It is the ideal *knotter* on all grades of pulp, *coarse screen* for groundwood, soda, sulphite or sulphate, *fine screen* for all grades of chemical pulp, bleached or unbleached.

Roll Surface Maintenance

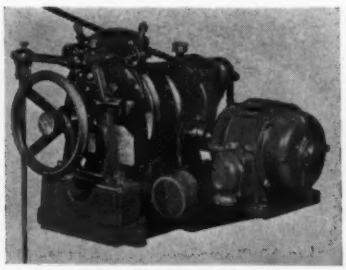
VICKERY DOCTORS keep papermaking roll surfaces in shape to do their best work at all times. They are essential to efficient operation of press rolls, wire rolls, breast rolls, dryers, calender and super-calender rolls.

Fibre Recovery



The BIRD SAVE-ALL keeps good stock from escaping with paper machine waste water, returns stock and water for immediate re-use at lowest net cost.

Stock Consistency Regulation



The BIRD CONSISTENCY REGULATOR holds consistency to within plus or minus 0.1%, handles stock from less than 1% to 12% consistency. It is effective and dependable for regulating stock at the paper machine chest, ahead of the Screens, ahead of the Jordans, ahead of the knotters.

BIRD MACHINE COMPANY

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General E. E. MacMorland of the Ordnance Department the program developed by Lt. W. S. Hassler continued with the detailed addresses by the representatives of the Navy procurement agencies:

"Results of Shipping Packages to the South Pacific Theater" by Lt. C. S. McNair and P. P. Kennedy of the Containers Section of the Bureau of Supplies and Accounts.

"Packaging Materials Required for Preservation" by Lt. (j.g.) D. R. Weedon, Jr., Philadelphia Naval Aircraft Factory.

"How to do Business with the Navy" by Lt. (j.g.) Robert Faegre.

"Paper and Container Conservation and Reclamation" by Frederic G. Barber, Containers Section.

The Army Program was organized by Major Malcolm J. Odell, Army Service Forces and included the following presentations:

"What the Quartermaster Expects from Paper Products" by Major Robert R. Melson, Chicago Quartermaster Depot.

"An Analysis of the Application of Paper Products to C.W.S. Packaging" by Lt. T. E. Steinmetz, Technical Division, Chemical Warfare Service.

"Marking Army Shipments" by Capt. George Wallerschein, Packing and Marking Branch, Office of the Chief of Transportation.

"Requirements of Protective Papers for Ordnance Overseas Packaging" by H. T. Holbrook and A. L. Wheton, Office of the Chief of Ordnance. (This address was a presentation of the problems that needed to be met in developing noncritical water vaporproof barriers, greaseproof wrappers and bag liners.)

"Problems in the Packaging of Signal Equipment" by Lt. W. F. Campbell of the Office of the Chief Signal Officer. (This was an analysis of the problems confronting the Signal Corps, particularly with the cushioning and packaging of delicate radio equipment and transmitter tubes, the use of molded pulp containers, and the uses of technical consultants of the industry in manufacturing plants.)

"What Can the Engineers Expect of Paper Packaging for Overseas Shipment?" by Major John C. Babson of the Office of the Chief of Engineers. (The subjects covered by Major Babson included insulation board, camouflage nets, cement, fireclay, bituminous products, surveyors instruments, sensitized papers and water-resistant barriers.)

W. E. Brawn
Member TAPPI Executive Committee

O. P. Gephart
Member TAPPI Executive Committee

"Packaging Medical Supplies for the Army" by James D. Studley of the Office of the Surgeon General. (This was an analysis of the Medical Department packaging problems offering opportunities for technical improvement of paper packaging materials.)

"Packaging Problems of the Army Air Forces" by Major Raymond A. Schmidt of the Army Air Forces.

These presentations were followed by a number of sessions in which the Army and Navy requirements were thoroughly discussed by representatives of packaging contractors, paper and container plants and officers of the Army and the Navy. The papers presented were widely distributed through a very large number of trade papers serving all industries. Through the medium of this great meeting the packaging requirements of the armed services were clearly and fully interpreted to all having to engage these problems. It would be impossible to estimate the thousands of man hours, travel miles, and costs saved. Subsequent reports by the procurement services indicated that this meeting served its purpose well and was an outstanding contribution to the war effort.

Clearing House for Paper Problems

The association has continued to be a clearing house for hundreds of inquiries from Army and Navy and civilian sources on specific paper and testing problems. At this early date it would probably be improper to indicate the nature of many of these inquiries, but it has been gratifying to note the versatility of the association membership in being able to supply experts on all questions asked and their wholehearted willingness to assist when called upon to do so, even to the extent of attending conferences which involved cost and travel time. For this the Technical Association is indebted to the many companies who supported the conference. In considering the Technical Association's value during a crisis such as the war it is evident that the great breadth of its members' interest, coupled with their years of experience and technical knowledge, have made it a reservoir of infor-

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mation ready to meet almost any emergency problem with which it might be confronted.

As in the case of the pulp and paper industry itself the association did not find it necessary to reconvert its services to meet the problems of war. By continuing its normal operations, stepped up with intensity in places, it best served the country. It was, in fact, the steady year-in-and-year-out continuation of its functions that made its contributions of value. Some of these activities will hereinafter be chronicled.

Three publications, however, were produced when most needed and should be noted. These were *Paper —The Lifeblood of Civilization, Saving Fourdrinier Wires* and the *TAPPI Bulletin.*

Paper—The Lifeblood of Civilization

Paper—The Lifeblood of Civilization, an illustrated booklet, was prepared and distributed to the extent of 100,000 copies as a contribution to the establshment of employment stability in the industry. At the time it was issued there was a feeling on the part of the industry's employees that they should get into other industries. It was not clear to them that the industry was essenial to the war effort. Relatively little consideration was given to their status by the Selective Service. High wages in war boom industries were an added attraction. The booklet described the over-all coverage of the industry as a producer of essential civilian and military materials. Later the shortage of pulpwood greatly emphasized the essentiality of the industry in wartime.

Saving Fourdrinier Wires

Saving Fourdrinier Wires, a 21-page monograph, was prepared to draw particular attention to one of the industry's major conservation problems. Without wire cloth the paper machines could not operate and there was a definite shortage of copper and other metals. The best immediate solution of the problem was to exercise every known way of extending fourdrinier wire life. The preliminary text was prepared, at the request of the Association, by J. E. Goodwillie of the Beloit Iron Works. The text was then carefully reviewed by a large number of paper mill superintendents in the Association and it was discussed in great detail by two large regional groups. The final product was as near perfection as it is possible to prepare such a text. About 5000 copies were printed and were distributed without charge to the membership and all companies requesting copies for the use of their machine operators.

A. E. Bachmann
Member TAPPI Executive Committee

C. R. Seaborne
Member TAPPI Executive Committee

The TAPPI Bulletin

At the TAPPI Convention held in Boston in the fall of 1942 a member inquired at one of the general sessions how the association proposed to provide a medium through which the members might exchange information that would coordinate and promote the war effort of the industry. As a result of this inquiry the Executive Committee established a periodical called the *TAPPI Bulletin* (Devoted to the War Effort of the Pulp and Paper Industry). This four-page 8½ by 11 inch publication is issued to the members of the Association and others who wish to subscribe, on a semimonthly basis. Each issue contains a vital feature article, together with sections devoted to new products, testing methods, paper and packaging specifications, current packaging, literature abstracts, activities of the technical association and miscellaneous items of wartime importance. This publication met a real need and has been well received by the industry as indicated by the large number of requests for additional copies of certain issues and the large amount of correspondence that has resulted from interest in the items printed. It has been of exceptional value in keeping the industry up to date relative to the availability of the hundreds of Army, Navy, Federal, and other specifications that have been issued during the past few years.

Association Work Is Continued

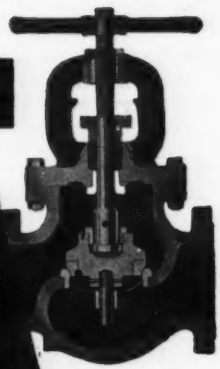
Although members of the association have been extremely busy the regular work of the association has proceeded with only a minor slowdown in some of its branches. The local sections have continued to hold meetings on reduced schedule. (In the case of the Empire State Section more meetings than usual were held due to the establishment of a policy of holding frequent meetings in various regions of New York. In this way the local groups were able to meet frequently because the transportation problem was reduced to a minimum). The association has local

GIVE THE VALVE A CHANCE ...SELECT IT FOR THE JOB

Today, when it is more important than ever before to keep pipe lines flowing at maximum efficiency, too much care cannot be given to selecting the right valve for each job. Before you "draft" a valve for that all-important line, make sure it is the one you really need.

Here is the answer to a frequently-asked question on valve selection, taken from the files of The Kennedy Valve Manufacturing Co. Other problems will be considered in succeeding advertisements in this series.

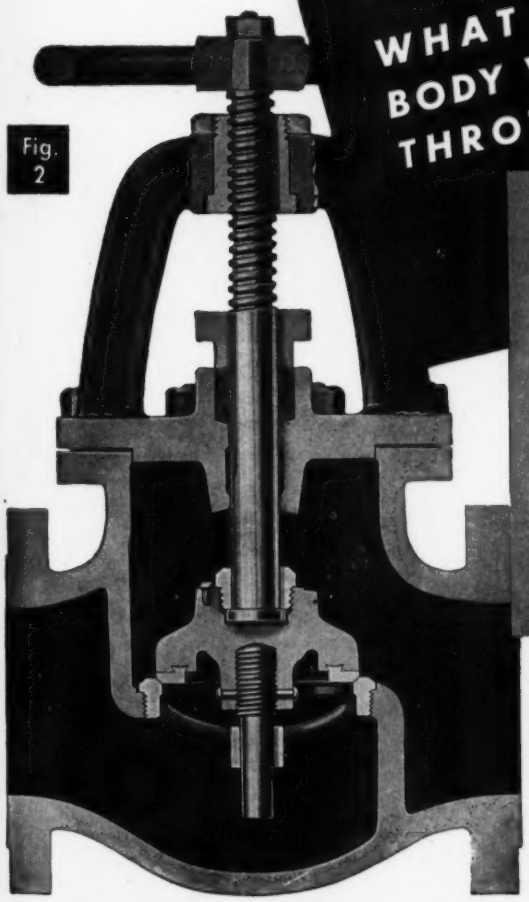
Fig. 1



Question:

WHAT TYPE OF IRON-BODY VALVE IS BEST FOR THROTTLING SERVICE?

Fig. 2



Answer:

Globe valves with renewable bronze-faced discs (see Fig. 2) are recommended for throttling service because, when gate valves are used, the high velocity of flow tends to erode their seating surfaces. For higher pressures, the globe valve disc should have a throttling lip or leader (as shown in Fig. 1) which makes the seat self-cleaning and minimizes wire-drawing.

FOR THROTTLING SERVICE SPECIFY IRON-BODY GLOBE VALVES WITH BRONZE-FACED DISCS.

If you have a valve section problem, write to us. As Kennedy makes a complete line of standard gate, globe, angle and check valves, you can be sure of receiving unbiased help. For full description of Kennedy valves, pipe fittings and fire hydrants, send for 240-page Kennedy Catalog.

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sections in New England, the Delaware Valley, New York State, Ohio, the Kalamazoo Valley, Wisconsin, and on the Pacific Coast. The programs of these regional meetings were devoted to the current operating and technical problems of the industry. Particular attention was given by some of the Sections to the most satisfactory ways of reusing old papers to help meet the pulp raw materials shortage.

Several years ago a speaker at a TAPPI meeting, Hollis Godfrey of the Engineering Economic Foundation, stated that "Material wealth is dependent on factual wealth and is preceded by it." In making any research investigation the first preliminary job is to review the literature on the subject. One of the great contributions to the material progress of the industry has been the publications of the Technical Association.

Bibliography of Papermaking

The key to all the literature of the industry is the annual Bibliography of Papermaking and United States Patents. This valuable annual, clothbound for permanence and hard usage is prepared by C. J. West, chairman of the TAPPI Committee on Abstracts and Bibliography. Through Dr. West's prodigious efforts the pulp and paper industry is the only industry in the world that has a complete record of its literature since 1900. There is no way of knowing how much time and money has been saved by the industry as a result of these bibliographies.

Other TAPPI Literature

Supplementing the bibliographies are the abstracts of these articles prepared by this same committee. Formerly these were run periodically in some of the trade papers, but in recent years they have appeared separately in books issued by the Technical Association. The association has also issued quarterly lists of U. S. patents, prepared by Dr. West and appearing in the TAPPI Section of the *Paper Trade Journal*. These services are of immense value to the industry and because of the regularity of their availability might be taken for granted like the air we breathe and the water we drink.

No small part of the literature of papermaking are the contributions by the association itself—the products of national and local meetings, the committees,

W. F. Gillespie
Member TAPPI Executive Committee

J. D. Malcolmson
Member TAPPI Executive Committee

the Association surveys, the Monographs, Special Reports on Manufacturing Problems, Standard Testing Methods Manual, Engineering Data Sheets, and miscellaneous publications not already mentioned.

Great Forums of Industry

The annual meeting of the Technical Association is one of the great forums of industry. Its program is the culmination of the year's activity. Held each year during Paper Week in New York in February it brings together the leaders of the industry who are interested in the steady advancement of manufacturing technology. In the fall the association usually meets in some city other than New York where the subjects under consideration are generally of regional or other special interests. The product of both of these meetings are the papers presented and the discussions thereof that appear in Technical Association Papers—a clothbound volume of 800 pages or more. This volume is considered to be the annual record of technical progress in the pulp and paper industry. Many of the papers contained therein are published in the trade journals throughout the world.

Cooperation of Paper Trade Journal

Special mention should be made at this time of the cooperation of the Lockwood Trade Journal Company with TAPPI. Each week in its *Paper Trade Journal* there appears several papers released by the Association, together with news items and informative notices. Although all of the meeting papers presented at the association meetings are not published by the Journal, because of space restrictions, it should be noted that many articles appear that are not meeting papers. These are original contributions received both by the association and the Journal throughout the year, standard testing procedures, local section papers and other original material. The Lockwood Trade Journal Company assists the association in many ways, particularly along publishing lines.

TAPPI Year Book

A cumulative summary of all of the association's activities and publications appears annually in the association's Year Book, a volume of more than

"Performance means everything to me"

"The cost of getting performance is important," says this mill man, "but it comes second."

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Jones

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E.D. JONES & SONS COMPANY-PITTSFIELD, MASS.

Builders of Quality Machinery for Paper Mills

350 pages. In this book, without fire or fanfare, appear the cold facts about the association's accomplishments, a list of the membership and sections dealing with the orderly procedure of carrying out the many and ramified activities of the organization.

TAPPI Special Reports

A series of publications known as the TAPPI Special Reports on Manufacturing Problems, has been appearing for more than a generation. Their processed typography belie their value and importance, or possibly emphasize it. About 350 of these documents have been issued. They are the results of nearly as many surveys on immediate manufacturing problems that have confronted members from time to time and bring together the opinions and experience of members who have been qualified to respond to the association's inquiries. They are the only publications of TAPPI that do not automatically go to each member, although members may have access to them and many are available for purchase at a nominal fee. Their distribution is restricted to the corporate members — manufacturers and converters of paper and to the individuals who have assisted in their preparation. This restriction, whether necessary or not, has been based on the principle that individuals may need this incentive to justify their efforts in making responses. Although some of the contributions may be of limited value the net result has been that the inquirer, at least, has received either the needed answer to his problem or a sufficient number of leads or ideas to set him on the right trail to the answer.

Over Two Thousand Members

The aforegoing mention of corporate membership possibly needs a brief explanation. The association now has in excess of two thousand individual members. Many pulp and paper manufacturers, by company membership, use this means of orderly contribution to forward the technological progress of the industry. The additional revenue obtained from this source enables the association to maintain a service greater than would be possible if its income were limited to that from individuals. It furthermore inspires the association to greater efforts because of the confidence reposed in its affairs by the progressive executives representing these companies.

A. E. Montgomery
Member TAPPI Executive Committee

F. W. Brainerd
Member TAPPI Executive Committee

Many companies that offer products and services to the industry constitute another class of member, namely sustaining membership. These companies have contributed tremendous values to the pulp and paper industry through their membership in the association. In addition to their generous financial support they have spent fortunes for the benefit of the industry through their applied reseach projects. Their prime interest in the association may be its utilization as a market development medium however it has been long recognized that their problems in relation to the industry have highly technical aspects and consequently there is a great need not only to report their technical findings to the industry's manufacturing executives, chemists, and engineers, but also to discuss with them the scientific fundamentals involved. This has assured the association meetings and committees the presence and direct attention of the most highly qualified experts that these companies have to offer.

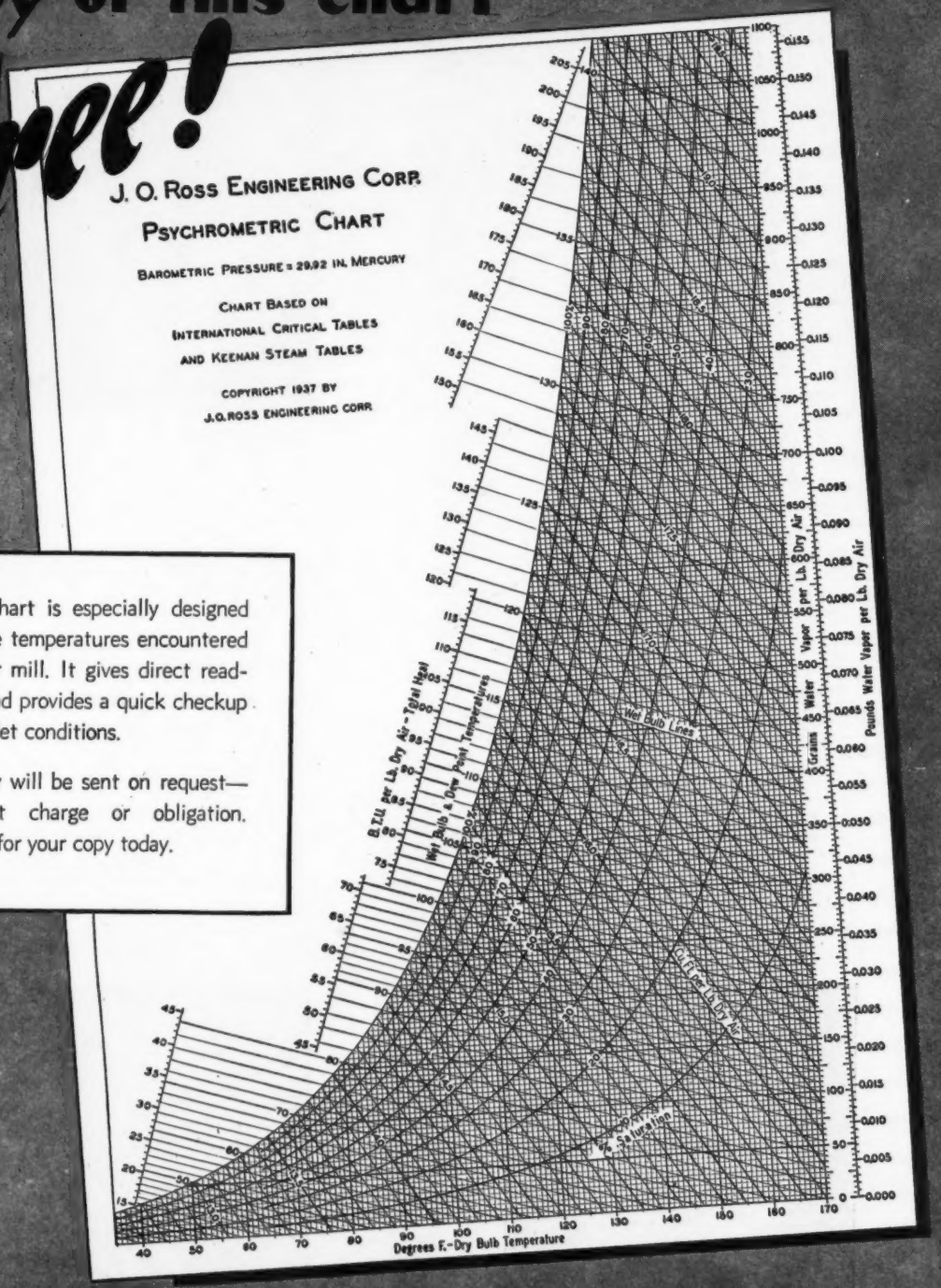
TAPPI Greatest Contribution

Probably the greatest contribution that the Technical Association has made to the field of pulp and paper has been the development of the methods of testing and evaluating the properties of pulp, paper and paper products and of the raw materials that enter into their manufacture. As in the case of most of the association's activities this work goes on from year to year without interruption. Even after the testing standards have been adopted they are everlastingly scrutinized for possible flaws or ways of improvement. The industry is acquainted with the completed results but probably is not acquainted with the years of painstaking effort that are represented in the development and round robin verification of these methods. These efforts, as before mentioned have been in part repaid by the recognition of a job well done by the specification units of the military and other national procurement agencies during the present difficult days.

Text Books on Pulp and Paper

It is unfortunate that the space limitations of this

Copy of this chart *Free!*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Psychrometric Chart
Barometric Pressure = 29.92 In. Mercury
Chart Based on
International Critical Tables
and Keenan Steam Tables
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Wet Bulb & Dew Point Temperatures
Wet Bulb Lines
Grains Water Vapor per Lb. Dry Air
Pounds Water Vapor per Lb. Dry Air
Cubic Feet per Lb. Dry Air
% Saturation
Degrees F.-Dry Bulb Temperature

This chart is especially designed for the temperatures encountered in your mill. It gives direct readings and provides a quick checkup on outlet conditions.

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CONTROL OF AIR FOR MODERN INDUSTRY

article makes it inadvisable to report the names of the many individuals who have for years contributed steadily and generously of their time and effort to bring about the many accomplishments of the association in all of its spheres of action. The membership of TAPPI is a great composite of ability relating to all phases of the industry's activities. When the association was formed in 1915 it was found difficult to assemble even one hundred members. Following the first World War the need for text books on pulp and paper became evident. This need was met through the joint efforts of the technical men in the United States and Canada who put together the contents of the now well known textbooks in five volumes entitled Manufacture of Pulp and Paper (published by the McGraw-Hill Book Company) and now distributed to the extent of 36,000 volumes.

TAPPI Data Sheets

In addition to the TAPPI Manual of Standard Testing Methods, Specifications and Recommended Practices the association has issued another loose-leaf perpetuating device known as the TAPPI Data Sheets. These have largely been prepared by the central office staff of the association, but contributions have been received from many sources. These sheets show, usually in graphic form, engineering and operating data of special value. Eventually this material will accumulate to an extent that will justify the publication of an Industry Engineering Handbook. The TAPPI effort in this field was preceded by a similar project by the Engineering Committee of the Technical Section of the Canadian Pulp and Paper Association. Both organizations have cooperated closely throughout their mutual period of existence.

TAPPI Medal

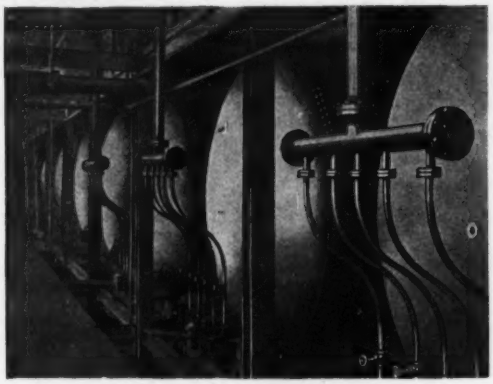
A ceremony that has featured some of the national meetings of the association has been the presentation of the TAPPI Medal to individuals who have made outstanding contributions to the technical advancement of the pulp and paper industry. To receive this award is to obtain the greatest honor that the industry has to bestow. Twelve individuals have been so recognized after very careful consideration by the executive committee of the Technical Association. The standards for making these selections have been high and are likely to continue so in order that it may continue to have the significance that has been established by the awards that have already been made.

J. C. NUTTER
Member TAPPI Executive Committee

The future success of the association as in the past will probably not be based on spectacular efforts of any kind but rather on the day by day search and dissemination of knowledge relating to pulp and paper. These facts and principles will continue to be the building blocks that will mark the steady advancement of the industry. The industry is unique in that its product is essentially a sheet that is made up of fibers obtained from living plants. The nature of these fibers is dependent on a multitude of influences controlled by nature. Each plant, whether it be a tree or an agricultural species has a life history unique to itself and every cell is a product of that experience and in going through the processes

K. P. GEOHEGAN
Member TAPPI Executive Committee

PIERRE DREWSEN
Member TAPPI Executive Committee



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Since 1887 BIGGS have been serving the Paper Industry throughout the world.

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14 ft. Diameter Rotary Digesters

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of pulp and papermaking makes its individuality felt, to a limited extent. Mass production tends to blend those influences and thereby simplifies the problem, but the publications and research findings over the years indicate the effort that has been necessarily made to acquire an increasingly better understanding of the nature of the fibers in suspension and eventually in the final product.

Everlasting Search for Knowledge

This everlasting search for knowledge is the major work of the technical men of the paper industry and TAPPI's function has been and is to provide the agency for interpreting these findings, submitting them to scrutiny of other technically trained men and finally to publish the facts and to establish the underlying principles involved. The transfer of a fiber from a plant to a sheet of paper or a paper product is the basis of a great industry and like other industries many factors are involved which require the attention of foresters, pulp makers, papermakers, engineers, chemists, physicists, accountants, salesmen, and executives of all kinds.

The problems are great. It is true that paper has been made centuries, but time brings demands for more papers of highly specific properties. There are more than one hundred measurable paper properties and these in a wide variety of control will continue to challenge the papermaker so that sheets which will meet high specific qualifications can be made. To attain this end there will need to be an engineering approach so that operating procedure can be specified in great detail. This will require a constant search for the fundamental principles involved.

Always Have Work to Do

Because of the recognition of this unfinished problem the committees of the Technical Association always have work to do. These problems are designated as committee projects and about 250 have been considered by TAPPI in the relatively few years during which the project system has been in effect. These tasks have resulted in standard testing methods, operating and engineering codes, meeting papers based on cooperative investigations, monographs, data sheets, and other publications.

To obtain these objectives the committees have held meetings and open forums, and have promoted research and investigations. In a number of cases the association has appropriated funds to finance limited research objectives in colleges and public institutions in order to obtain certain information needed by committees. In addition no little credit should be given to the individual committeemen who have worked independently to obtain information for the benefit of a committee project. Reams of paper have been used by committee men in corresponding with the chairmen and others throughout the year about details relating to these objectives. Too little recognition has gone to the hundreds of TAPPI members who have devoted time and effort to the committee work of the association. It is evident that their desire to contribute toward the advancement of knowledge has been greater than their desire for applause. It is hoped and it is very likely that their recognition has come from individuals who could do them the most good and were appreciative of their display of initiative and understanding. The association finds many ways to recognize efforts on the part of its members but again many have quietly cooperated without looking for fee or reward. The industry is also indebted to the companies employing many of these members for their willingness to allow their men to contribute some of the knowledge for the general welfare of the industry.

The association will continue to strive to advance the industry and to search for and disseminate knowledge, and the Year Book and other publications of the Technical Association of the Pulp and Paper Industry will cumulatively record the progress made as time marches on.

FINANCIAL NEWS

New York Stock Exchange

High, Low and Last for Week Ending September 9, 1944

STOCKS

	High	Low	Last
A. P. W.	4⅜	3½	3½
Armstrong Cork Co.	44½	42¼	42¾
Celotex Corp.	14½	13⅝	13⅝
Celotex Corp., pf.	18⅜	18	18⅜
Certain-Teed Products Corp.	7	6¼	6½
Certain-Teed Products Corp., pf.	109½	103	104½
Champion Paper & Fibre Co.	28	26	26¾
Champion Paper & Fibre Co., pf.	112¼	111¾	111¾
Congoleum Nairn Co.	27⅜	25	25
Container Corp. of America	27	25⅛	25⅜
Continental-Diamond Fibre Co.	11⅜	10¾	10¾
Crown-Zellerbach Co.	19⅜	18⅛	18¾
Crown-Zellerbach Co., pf.	102¾	102	102⅜
Dixie Cup Co.	19	18	19
Dixie Cup Co.,—A.	48	47	47
Flintkote Co.	24⅜	22⅝	22¾
Flintkote Co., pf.	108	107½	107½
Robert Gair	4⅞	4⅜	4⅝
Robert Gair, pf.	16½	14¾	15½
International Paper Co.	20½	18⅜	19⅛
International Paper Co., pf.	83⅜	81⅞	82½
Johns-Manville Corp.	98	94¾	94¾
Johns-Manville Corp., pf.	...	...	...
Kimberly-Clark Corp.	40	39	39
MacAndrews & Forbes	29⅜	29⅜	29⅜
MacAndrews & Forbes, pf.	...	...	...
Masonite Corp.	45½	43	43½
Mead Corp.	11⅝	10⅜	11
Mead Corp., pf. A—6%	100	100	100
Mead Corp., pf. B—5½%	86½	86½	86½
National Container Corp.	22¼	20½	21½
Paraffine Companies, Inc.	54	53½	53½
Paraffine Companies, Inc., pf.	...	...	...
Rayonier, Inc.	17½	16¾	16¾
Rayonier, Inc., pf.	31¾	31⅛	31½
Ruberoid Co.	33¼	32	32
Scott Paper Co.	42⅛	42⅛	42⅛
Scott Paper Co., pf.	109½	109	109½
Sutherland Paper Co.	31	30¼	30¼
Union Bag & Paper Corp.	13¼	12⅛	12½
United Paperboard Co.	6⅜	6	6¼
U. S. Gypsum Co.	79½	76	78¼
U. S. Gypsum Co., pf.	180	179¾	180
West Virginia Pulp & Paper Co.	23½	21	22¼
West Virginia Pulp & Paper Co., pf.	108⅛	108⅛	108⅛

BONDS

Abitibi Pulp & Paper Co. 5s '53	89¾	87½	87¾
Celotex Corp. 3¾s '55	104	104	104
Certain-Teed Products Corp. 5½s '48	102	101¾	101¾
Champion Paper & Fibre Co. 4¾s '50	...	...	...
International Paper Co. 6s '55	108⅞	108¼	108¾
International Paper Co. 5s '47	104⅛	103½	103½
Mead Corp. 3½s '53	...	...	...
West Virginia Pulp & Paper Co. 3s '54	...	...	...

New York Curb Exchange

High, Low and Last for Week Ending September 9, 1944

STOCKS

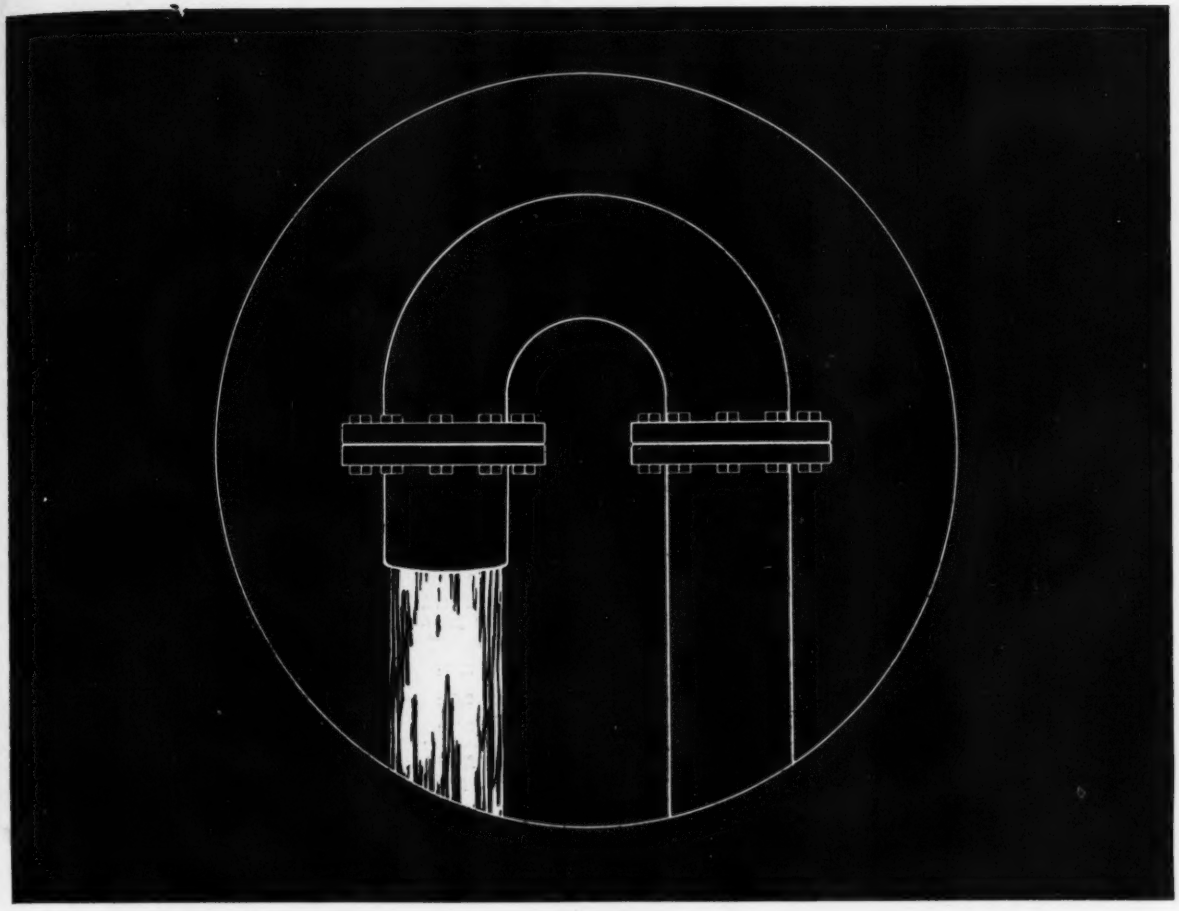
	High	Low	Last
Great Northern Paper Co.	35	34¼	34¾
Hummel-Ross Fibre Corp.	8	6¾	6¾
St. Regis Paper Co.	6⅛	5¼	5⅛
St. Regis Paper Co., pf.	...	...	...
Taggart Corp.	6	5¼	6

BONDS

American Writing Paper Co. 6s '61	101¼	100½	100½

Chicago Salesmen Hold Luncheon

The Western Division of the Salesmen's Association of the Paper Industry opened its fall season on September 11 at the Hotel Sherman, Chicago, when the noon luncheon sessions was renewed under the supervision of Pat Patterson, Flambeau Paper Company, vice president of the division. It is reported that the association will schedule open meetings with featured speakers at least once a month.



Slime-free Pipes

"ALWAYS OPEN FOR BUSINESS" describes the slime-free pipes in those mills using "Lignasan"—the powerful bactericide and fungicide that controls slime-forming bacteria in unbleached sulphite pulp systems.

When you add "Lignasan" to your pulp, you reduce clogging of pipes, screens and rifflers . . . you cut down on the time and labor spent on washups and cleanings . . . you safeguard stock against bacterial and fungous attacks . . . you protect sugars, starches and adhesives from decomposition by bacteria.

"Lignasan" is extremely effective even in low concentrations. Added at the beater in powder form, 3 to 5 ounces per ton of dry fiber usually can be relied upon to control slime throughout the *entire* "wet" paper-making cycle. Or, "Lignasan" may be bled into the system at *any* point where slime formation tends to be excessive.

Many mill operators have credited "Lignasan" with substantial savings. Get the facts *today* on how "Lignasan" can help *you* curb profit-stealing slime, cut production costs and keep your mill at peak operating efficiency. Write our nearest branch office or E. I. du Pont de Nemours & Co. (Inc.), Grasselli Chemicals Department, Wilmington 98, Delaware.

INVEST IN VICTORY—BUY WAR BONDS

CONTROLS SLIME
PRESERVES PULP

Du Pont Lignasan

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BACTERICIDE AND FUNGICIDE

DUPONT

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Printing Committee Opens Bids for Paper For Government Printing Office

WASHINGTON, D. C., September 11, 1944—Bids were received from twenty-seven bidders today by the Joint Congressional Committee on Printing for paper for the use of the Government Printing Office for the three months period beginning October 1. The Committee will meet September 18 to consider awards. The bids were as follows:

Newsprint

No. 1—1,500,000 lbs., 24x36—64; rolls, 19, 24, 36 and 48 ins. wide (3-inch fiber cores, weight of cores and wrappers shall be included in net weight).
No bids

Telephone Book News

No. 2—300,000 lbs., 24x36—45; rolls, 28, 38 and 48 ins. wide (3-inch fiber cores). (Weight of cores and wrappers shall be included in the net weight.)
Bermingham & Prosser Co. 5.38c
Central Ohio Paper Co. 6.15c

Machine-Finish Book

No. 3—200,000 lbs., 25x38—70; flat, cut 22½x31, 28½x48; 31¼x45½, 32x42 and 42x64 ins.
Marquette Paper Corp. .....
(ceiling price)
(maximum 600,000 pounds) 7.98c

No. 4—400,000 lbs., 25x38—70; flat, cut 24x38, 28x38, and 38x48 ins.
Barton, Duer & Koch Paper Co.
(total 500 tons for all items 4, 5, 7, 8 9 and 10) 7.95c
Marquette Paper Corp. .....
(ceiling price)
(Maximum 600,000 pounds) 7.89c

No. 5—400,000 lbs., 25x38—70; flat, cut 24x38, 28x38, and 38x48 ins.
Barton, Duer & Koch Paper Co...
(total 500 tons for all items) 4, 5, 7, 8, 9 and 10 7.95c
Marquette Paper Corp. .....
(ceiling price)
(Maximum 600,000 pounds) 7.89c
Graham Paper Co. 7.89c

No. 7—400,000 lbs., 25x38—70; rolls, 19 and 38 ins. wide (3-inch fiber cores).
Paper Corp. of U. S. 7.20c
Barton, Duer & Koch Paper Co...
(500 tons for 4, 5, 7, 8, 9 and 10) 7.55c
Mudge Paper Co. 7.09c
Perkins, Goodwin Co. 7.12c
Marquette Paper Corp. .....
(ceiling price—maximum 600,000 pounds) 7.34c
Frank Parsons Paper Co. 7.5854c

No. 8—400,000 lbs., 25x38—70; rolls, 19 and 38 ins. wide (3-inch fiber cores).
Paper Corp. of U. S. 7.10c
Barton, Duer & Koch Paper Co...
(500 tons for 4, 5, 7, 8, 9 and 10) 7.55c
The Butler Co. .....
(300,000 pounds only for items 8, 9, and 10) 7.30c
Mudge Paper Co. 7.09c
Perkins, Goodwin Co. 7.12c
Marquette Paper Corp. .....
(ceiling price, maximum 600,000 pounds) 7.34c
Frank Parsons Paper Co. 7.5854c

No. 9—200,000 lbs., 25x38—70; rolls, 24, 36, and 48 ins. wide (3-inch fiber cores).
Barton, Duer & Koch Paper Co...
(500 tons for 4, 5, 7, 8, 9 and 10) 7.55c

No. 10—150,000 lbs., 25x38—80; flat, cut any size, min. width 24 ins., max. width 48 ins.
Butler Co. .....
(300,000 pounds for items 8, 9 and 10) 7.30c
Central Ohio Paper Co. 7.34c
Mudge Paper Co. 7.09c
Marquette Paper Corp. .....
(ceiling price, maximum 600,000 pounds) 7.60c
Barton, Duer & Koch Paper Co...
(500 tons for 4, 5, 7, 8, 9 and 10) 7.40c
Butler Co. .....
(300,000 lbs. for 8, 9 and 10) 7.30c
Central Ohio Paper Co. 7.35c

Machine-Finish Book End Paper

No. 18—80,000 lbs. Flat, cut 25x38 ins.; 160 lbs., the grain to run the 38-inch way.
No bids

Offset Book

No. 19—1,500,000 lbs., 25x38—80; flat, cut 29x41, 32x42, 34x44, 38x48, 39x53, 42x58 and 44x64 ins., the grain to run lengthwise of the sheet.
Paper Corp. of U. S. .....
(500,000 lbs. only) 8.69c
North American Pulp & Paper Co.
(100,000 lbs. only) 8.68c
Central Ohio Paper Co. .....
(300,000 lbs. only for 19 or 20) 8.70c

No. 20—3,000,000 lbs., 25x38—100; flat, cut 29x41, 32x42, 34x44, 38x48, 39x53, 42x58 and 44x64 ins., the grain to run lengthwise of the sheet.
Wilcox, Walker & Furlong Co...
(400,000 lbs. only) 7.56c
North American Pulp & Paper Co.
(200,000 lbs. only) 7.80c
Central Ohio Paper Co. .....
(300,000 lbs. only for 19 or 20) 7.57c

Antique Book

No. 22—50,000 lbs., 25x38—90; flat, cut 33x43 and 38x50 ins.
Mead Sales Co. 7.18c

50 Per cent Antique Book

No. 26—80,000 lbs., 25x38—80; flat, cut 38x48 ins.
Whitaker Paper Co. .....
(40,000 lbs. Nov.
40,000 lbs. Dec.) 14.94c

Supercalendered Book

No. 33—200,000 lbs., 25x38—90; flat, cut any size, min. width 24 ins., max. width 48 ins.
R. P. Andrews Paper Co. 7.69c

No. 34—400,000 lbs., 25x38—90; rolls, 28½ and 38 ins. wide (3-inch fiber cores).
R. P. Andrews Paper Co. 7.33c
Central Ohio Paper Co. 7.48c
Mudge Paper Co. 7.33c

Machine-Coated Book

No. 37—1,500,000 lbs., 25x38—90; flat, cut 28½x48, 31¼x45½, 32x42, 35x45, 36x56, 38x48, 39x50 and 44x68 ins.
Barton, Duer & Koch Paper Co... 6.47c

No. 38—1,000,000 lbs., 25x38—100; flat, cut any size, min. width 24 ins., max. width 48 ins.
Barton, Duer & Koch Paper Co... 7.04c

No. 39—200,000 lbs., 25x38—120; flat, cut any size, min. width 24 ins., max. width 48 ins.
Barton, Duer & Koch Paper Co... 6.55c

Coated Book

No. 41—100,000 lbs., 25x38—140; flat, cut 38x48, 39x50, and 41x52 ins., the grain to run lengthwise of the sheet.
Consolidated Water Power & Paper Co. 6.56c
Kennelly Paper Co., Inc. 9.15c
Perkins, Goodwin Co. .....
(50,000 lbs. only in any one month) 9.15c

Dull Coated Book

No. 42—50,000 lbs., 25x38—140; flat, cut 28x41 ins., the grain to run lengthwise of the sheet.
No bids

Ground Wood Mimeograph

No. 44—2,000,000 lbs., No. 36; flat, cut 32½x42½, and 38x48½ ins., grain as ordered.
Meade Sales Co. .....
(600,000 lbs only) 5.80c
Marquette Paper Corp. .....
(400,000 lbs. only) 5.75c
Old Dominion Paper Co. .....
(400,000 lbs. only) 5.7988c
(400,000 lbs. only) 5.8944c

Chemical Wood Mimeographed, White and Colored

No. 45—1,000,000 lbs., white, No. 36; flat, cut 32½x42½ and 38x48½ ins.; the grain to run as ordered.
Whitaker Paper Co. .....
(400,000 lbs. only) 7.17c
Eastern Corp. .....
(bid limited to 325 tons month on all items) 8.63c
R. P. Andrews Paper Co. .....
(500,000 lbs. only) 7.24c

No. 46—100,000 lbs., blue, buff, green, pink and yellow, No. 36; flat, cut 32½x42½ and 38x48½ ins., the grain as ordered. Min. order, one color, 10,000 lbs.
Cauthorne Paper Co. 8.25c

25 Per Cent Mimeograph

No. 47—100,000 lbs., No. 36; flat, cut 32½x42½; 34½x44, and 38x48½ ins.; the grain to run as ordered.
Aetna Paper Co. 9.56c
Old Dominion Paper Co. 9.63c

Blue U S M O Safety Writing

No. 48—250,000 lbs., No. 32; rolls, 22 ins. wide, 24 ins. in diameter (3-inch fiber cores).
R. P. Andrews Paper Co. 12.83c

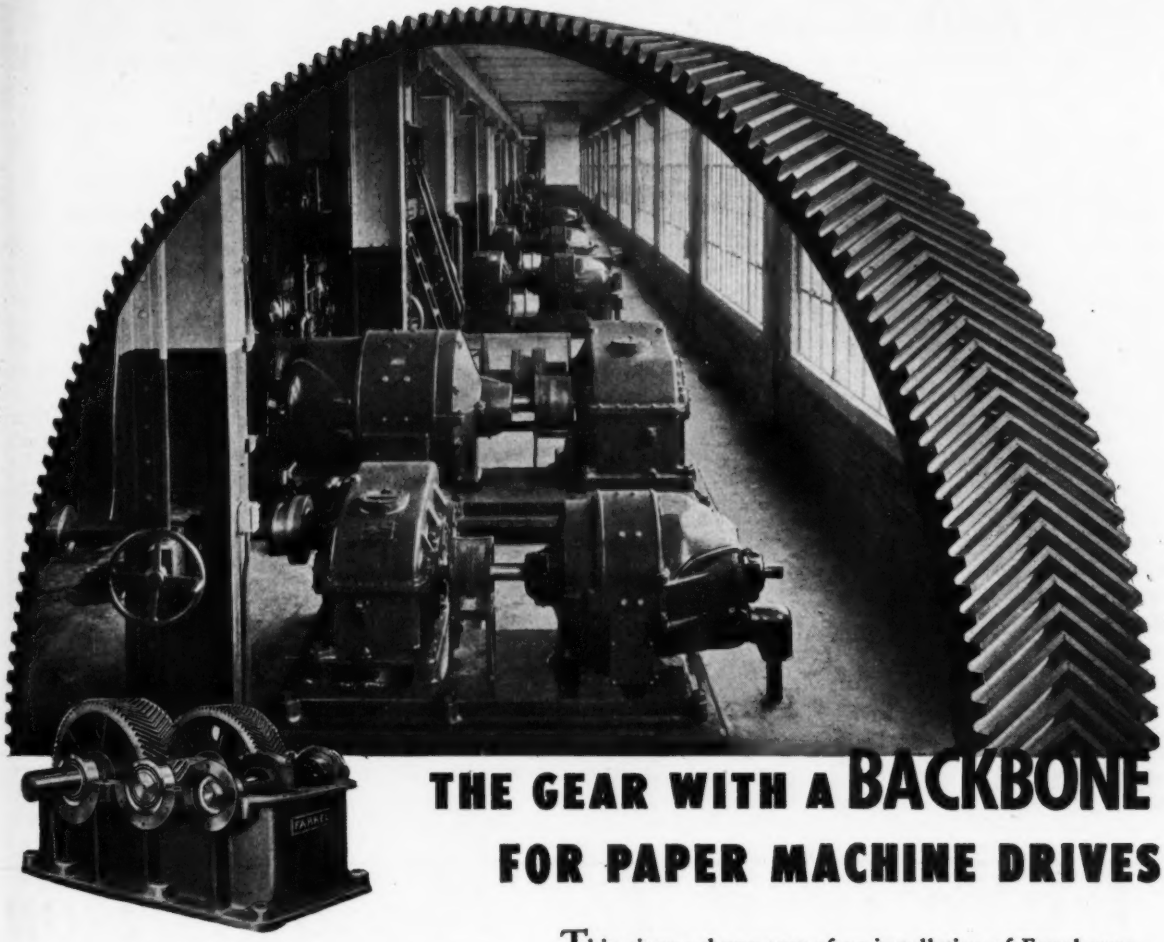
Ground Wood Writing, White and Colored

No. 51—1,000,000 lbs. white, No. 36; flat, cut any size, min. width 28 ins., max. width 48 ins.
Millcraft Paper Co. .....
(200,000 lbs. only) 6.40c
Frank Parsons Paper Co. .....
(400,000 lbs. only) 6.40c

Chemical Wood Writing, White and Colored

No. 55—2,000,000 lbs., white, No. 32; flat, cut any size, min. width 21 ins., max. width 48 ins.
Whitaker Paper Co. .....
(maximum 800,000 lbs. one or all lots) 7.69c
Barton, Duer & Koch Paper Co...
(total 250 tons for all items) 7.80c
Marquette Paper Corp. 7.85c

(Continued on page 121)



THE GEAR WITH A BACKBONE FOR PAPER MACHINE DRIVES

This picture shows part of an installation of Farrel gear reduction units and Gearflex couplings, driving two 234" machines in a southern kraft paper plant. The twelve drives on each machine range in size from 30 HP single reduction to 275 HP double reduction, transmitting motor power and reducing motor speeds to the RPM required for suction and smoothing presses, dryers, couches, calenders and reels.

The gears in these units are the well-known Farrel-Sykes design, in which the two helices meet to form continuous teeth, instead of being separated by a center groove, as is the case with some gears. The meeting place of the two helices is called the *backbone*, because it provides extra strength and higher load-carrying capacity in small space.

This is only one of the advantageous features of Farrel gear units. Precision generated gear teeth, accurately machined shafts properly mounted in roller bearings, and heavy section cases that hold rotating elements in precise alignment, assure maximum efficiency, and smooth quiet operation under all service conditions.

For the complete story of Farrel gear units send for a copy of 80-page illustrated catalog No. 438. No cost, no obligation.

FARREL PAPER MILL MACHINERY

ROLLS: Chilled Iron, Dry Sand, Meehanite, Alloy Iron, Steel, Chromium Plated

FOR: Calender Stacks
Board Calenders
Super Calenders
Glassine Calenders
Friction Rolls
Breaker Rolls
Smoothing Rolls
Coating Rolls
Creping Rolls
Plater Rolls
Cutting Rolls
Paraffining and Waxing Rolls
Saturating Rolls
Silicating Rolls
Miscellaneous Special Purposes

CALENDERS: Paper and Board
GRINDING MACHINES: Roll
CALIPERS: Roll
GEARS, CUT: Spur, Single and Double Helical (Farrel-Sykes Continuous Tooth Type)
SPEED REDUCING GEAR UNITS
SPEED INCREASING GEAR UNITS
FLEXIBLE COUPLINGS

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONN. • BUFFALO, N. Y.
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles

Farrel-Birmingham

Paper Production for July

The following data cover all known mills and represent a continuation of the monthly statistics initiated in "Facts for Industry," series 24-2-1. For annual data and a description of the statistics, "Facts for Industry," series 24-1-2 should be consulted. All inquiries concerning these data should be addressed to the Bureau of Census, Washington 25, D. C.

Type of paper	1944 July	1944 June[1]	1943 July
All types	1,325,711	1,460,686	1,393,578[2]
Newsprint	59,600	61,109	68,590
Groundwood papers	40,516	44,959	45,647
Printing	15,055	19,014	13,861
Specialties	25,461	25,945	31,876
Book papers	103,567	120,927	130,249
General printing	74,639	85,998	92,259[3]
Converting papers	28,762	34,757	37,439
Other book papers	166	172	551
Fine papers	69,941	79,709	82,450
Writing papers	52,011	60,665	63,162[3]
Cover and text	4,823	3,365	4,820
Reproduction	2,825	4,284	2,824[4]
Bristols[4]	5,318	6,332	7,483[3]
Thin papers	4,818	4,958	4,080
Other fine papers	146	105	81
Wrapping papers	147,639	163,140	160,581
Bag papers	28,583	31,054	46,027
Glassine	6,164	6,836	6,939
Greaseproof	1,715	2,526	2,365
Vegetable parchment	2,245	2,669	2,786
Converting papers	57,779	65,084	47,758[3 5]
Wrapping papers	51,153	54,971	54,706[3 5]
Multi-wall sack papers	31,832	33,291	27,481
Special industrial papers	18,794[5]	22,727[5]	14,270
Sanitary papers	61,717	69,075	61,658
Tissue papers	12,520	12,558	13,784
Absorbent papers	6,728	7,323	7,778
Building papers	66,538	73,999	73,867
Paperboard	706,319	771,869	707,213
Container board	347,954	372,996	330,323
Folding boxboard	157,530	179,659	168,844
Set-up boxboard	57,530	67,499	68,924
Cardboard	4,688	5,987	4,767
Building board	86,734	88,938	87,965
Miscellaneous other board	51,883	56,790	46,390
Tube stock	32,423	34,995	26,978

[1]Revised.
[2]Includes a small quantity of paper not classified by type.
[3]Data revised to conform with certain changes in paper and paperboard classifications which became effective beginning January 1944. For figures covering other months of 1943, see "Facts for Industry," Series 24-2-5, Table 2.
[4]Includes Government Postal Card Stock.
[5]Includes a small quantity of Special Industrial Papers having a basic weight of less than 100 pounds. Such paper was classified as Wrapping Paper prior to January 1944.

Henley Paper Co. Incorporates

The Secretary of State for North Carolina has issued a certificate of incorporation to the Henley Paper Company of Charlotte. The company was granted a charter to operate a business for the purpose of selling and distributing paper and any and all products incident thereto. The new business has an authorized capital stock of $100,000, subscribed stock $300 by A. B. Henley, Macy T. Henley and Owen Reese, all of High Point. The new corporation will carry on the business formerly conducted under the style of the Parker Paper Company with headquarters at High Point, N. C.

Appoints Traffic Committee

[FROM OUR REGULAR CORRESPONDENT]

BOSTON, Mass., September 11, 1944 — Samuel L. Ginsburg, president of the New England Paper Merchants Association, Inc., has appointed the following members to serve on the Traffic Committee:

Paul A. McGreenery, Carter Rice & Co., Corporation, chairman; John F. Blackman, D. F. Munroe Company; Charles A. Burrell, Stone & Forsyth Company; Philipp Richardson, Storrs & Bement Company, and Edward H. Little, John Carter & Co., Inc.

We're in it for the duration

SINCE 1828

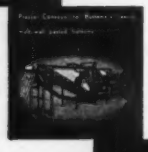
Continuously We Have Served The Paper Industry.

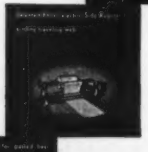
Since War II was declared we have used all our manufacturing facilities, and done our small part to help build our fighting machine for war.

At the same time we have been planning for peacetime equipment and improvements NOW!

We have some of our machines available to produce new machinery for civilian products.

Paper Machines
Paper Bag Machines **Paper Cutters**
Can be built with a PDIA Priority rating.





THE SMITH & WINCHESTER
MANUFACTURING COMPANY
PLANT AND OFFICES AT SOUTH WINDHAM, CONNECTICUT

Laboratory evidence of high quality is always *impressive*. But, consistently superior performance in actual service, year after year, in hundreds of mills—that's *conclusive* . . . That's the undisputed record of Heppenstall E.I.S. Chipper Knives, a record that is confirmed with a flat *guarantee*—that "Heppenstall E.I.S. Chipper Knives will show a unit cost below *any* other knives on the market" . . . Why pay the high cost of using a less efficient knife? Write for quotations. Heppenstall Company, Pittsburgh, Pa.

It's easy to eulogize an ordinary product, but with a proved champion

HEPPENSTALL

E. I. S. Chipper Knives

Buys Pomona Pump Firm

Fairbanks, Morse & Co. have purchased the Pomona Pump Company, a division of Joshua Hendy Iron Works in a $4,000,000 transaction.

Announcements of the sale were made simultaneously in Chicago by R. H. Morse, Jr., general sales manager of Fairbanks-Morse, and in Sunnyvale, Cal. by Charles E. Moore, president of the Joshua Hendy Company. The sale was effective as of September 2.

All physical assets, patents and trade-marks of the Pomona and Westco pump lines were included in the transaction. The Pomona firm has plants in Pomona, Cal. and St. Louis, and has been doing approximately 7 to 8 million dollars worth of business annually. With acquisition of this line, Fairbanks-Morse becomes the world's largest manufacturer of turbine pumps.

No changes in personnel are contemplated and, according to Morse, Arnold G. Brown, general sales manager of the Pomona company, becomes assistant manager of the Fairbanks-Morse Pump Division in charge of Pomona and Westco products. Distribution and sales will continue under Brown's direction.

In announcing the purchase, Morse said: "Fairbanks, Morse & Co., recognizes its responsibility to serve distributors and dealers. Towards that end plans already have been made to increase manufacturing facilities at the earliest opportunity."

The Pomona open impeller turbine pumps of the water-lubricated type have a highly successful record in irrigating, industrial and municipal services. The Westco line is manufactured largely for industrial and home water system uses.

Morse pointed out that acquisition of the Pomona company will augment the Fairbanks-Morse line of pumps, and that this is an addition to the Fairbanks-Morse pumps now being manufactured.

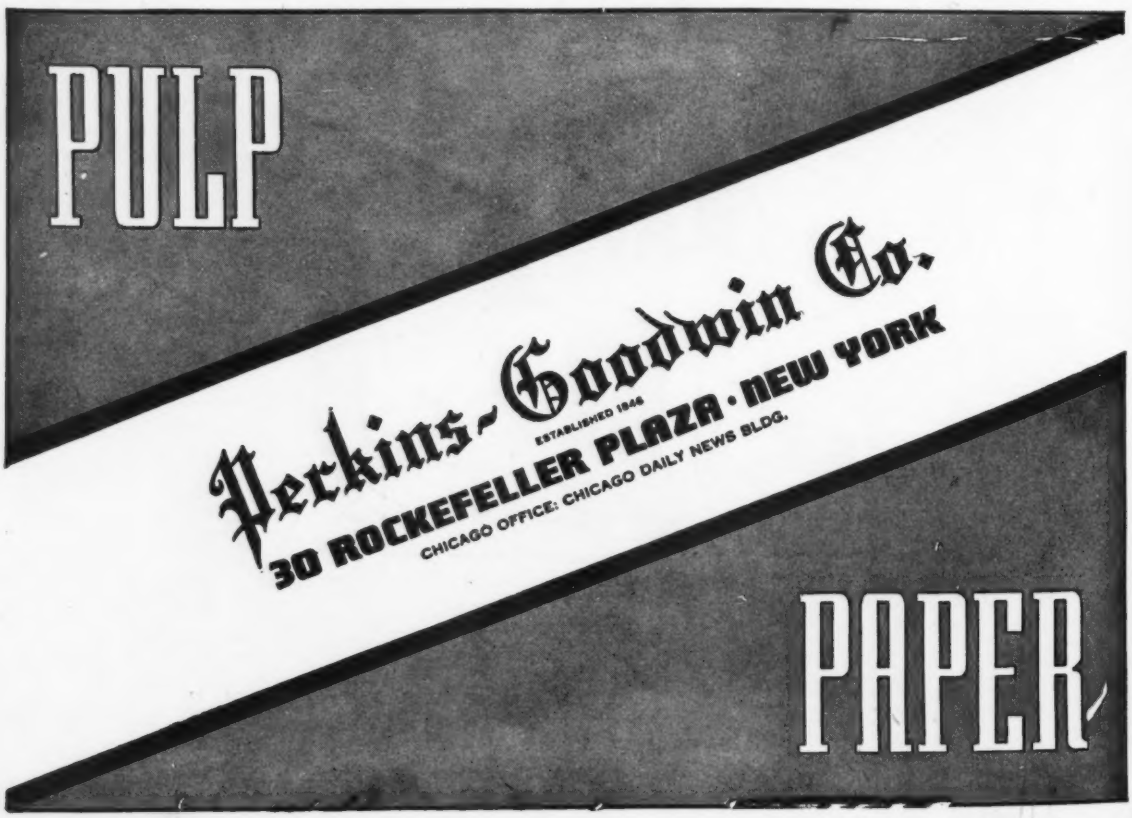
Hereafter the Pomona pumps will be known as Fairbanks-Morse-Pomona, and Fairbanks-Morse-Westco line.

Currencies Will Affect Paper Cases

A long series of cases involving the conversion of foreign currencies in the computation of duties on imported papers will be affected by a decision of the United States Court of Customs and Patent Appeals, according to Warren B. Bullock, manager of the Import Committee of the American Paper Industry. The case in which the decision was rendered involved woolen fabrics from England, but the principle affects shipments of groundwood papers from Canada, papeteries from England as well as other papers. In computing duties, Customs officials have used the official Pound sterling, or the Canadian dollar, and not the so-called "free" pound or dollar. The importer in the woolen case claimed that the "free" pound should have been the basis, thereby reducing the duty paid. The Court in its decision held that the instructions of the Secretary of the Treasury to use the official value of the pound was not subject to judicial inquiry.

L. C. Barkley To Be Manager

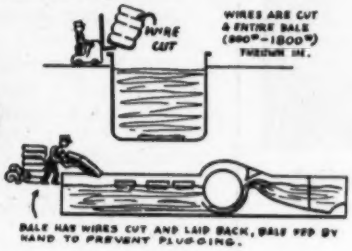
Littleton C. Barkley, manager of the New York Office of the Manhattan Rubber Manufacturing Division of Raybestos-Manhattan, Inc., has been appointed sales manager of the Manhattan Mechanical Rubber Goods Sales Department. Mr. Barkley's appointment was announced by Harry E. Smith, general manager of the Manhattan Rubber Manufacturing Division. For the present his office will be located at 120 Broadway, New York City.



VS. HYDRAPULPER

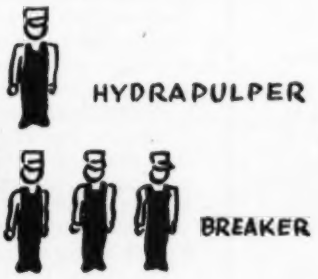
IF your breaker must be *replaced*, there is no time to lose in deciding what to do. You may be thinking "breaker" or you may be thinking "hydrapulper." To assist you in the matter we make a step by step comparison of the two units. The data that follows is based on 125 ton system.

FEEDING



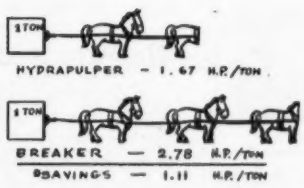
• Feeding a Hydrapulper seems entirely unorthodox. Complete bales (wire, brickbats and all) are thrown in. No sorting is necessary. No storage space around pulper is necessary.

LABOR



• One man can supervise the entire system, due to its compactness and act as his own roush crew to bring paper to pulper, using an electric or gas tractor truck. The average 125 ton system would require at least 3 men on the breaker to adjust, feed, and bring paper to breaker.

POWER



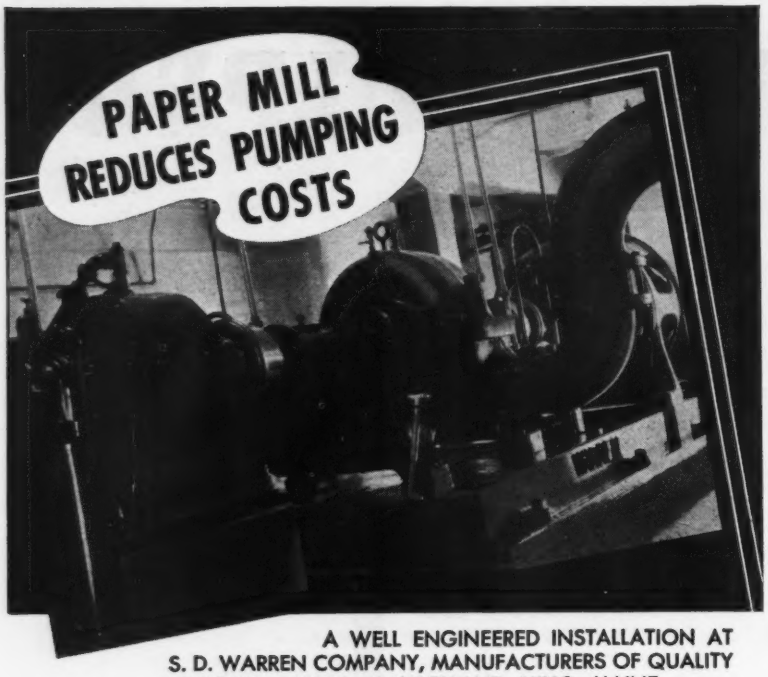
• Power savings per ton will of course vary according to the mill layout. As a rule, however, it is substantial enough to warrant a full investigation on your part and a request that your mill be surveyed by our engineers to ascertain whether you actually need a Hydrapulper. Ask for a copy of "Theory and Practice of Dilts-Cowles Hydrapulper" by Edward Root and R. F. Vokes.

SHARTLE

Dilts

Divisions of: The Black-Clawson Co., Hamilton, Ohio

WORKS • **Fulton, New York**



A WELL ENGINEERED INSTALLATION AT S. D. WARREN COMPANY, MANUFACTURERS OF QUALITY PRINTING PAPERS, CUMBERLAND MILLS, MAINE . . . ASSISTED BY A **WARREN PUMP.**

Paper Mills place a premium on reliability and performance. At Cumberland Mills the plant hydraulic elevator pump has a dual drive turbine and synchronous motor.

The turbine driver is used to regulate heat balance and to supply process steam. Pump requirements are thus served with by-product power. The synchronous motor generates when the steam demand exceeds the pump load and operates as a motor when the demand is less. Pump power costs are reduced to a minimum.

In addition to building pumps for every paper mill service, Warren cooperates with plant engineers in working out money-saving installations.

WARREN PUMPS

ARMY E NAVY

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASSACHUSETTS

Many Orders Unfillable

INDIANAPOLIS, Ind., Septembre 11, 1944 — Little change was seen last week in the general paper picture. Civilian demand continued to be large with many orders unfillable. This situation is expected to continue for some time to come, at least until after the first of the year. Many executives here believe that with Germany out of the war by the end of the year, there will be some easing of the general situation.

Print paper, of course, is in good demand, but the publishers generally are scaling down their paper sizes and are refusing advertising that ordinarily would be gratefully accepted. Papers in the smaller communities are particularly hard hit, it is reported.

A good demand for building paper and roofing has developed this fall and it is believed that building restrictions will have been removed to a large extent by the first of the year. If so, there is an immense volume of new construction planned for next year. At present stocks in the hands of jobbers seem quite ample to care for the demand. Prices are strong.

Tissues moved well last week, even though some cleaning tissues are scarce. The summer specialty demand continued fair last week, but it will slump rapidly from now on.

Box factories here are working to the limit of their productive capacity and manpower. A big backlog of orders is on file and some of them likely never will be filled. Executives believe that they will be able to augment their plant forces when Germany is whipped and the army begins discharging soldiers. The factories were hard hit by selective service and the larger money being paid by the numerous war industries in the city.

Mill demand for all grades of waste paper continued heavy last week. American Legion posts of this county are planning a paper collection campaign for September 24, when 250 trucks will collect paper throughout the county and a goal of 1,500 tons has been set.

No Paper Made in Nicaragua

There is no local production of paper in Nicaragua and any development of such an industry in the postwar period is unlikely, says a report recently received at the Department of Commerce.

Although consumption of paper in Nicaragua has advanced steadily during the past few years, a major portion of the increase can be attributed to temporal factors such as generally better business conditions, establishment of additional government offices and agencies, work on the Inter-American Highway, which necessitates a large personnel force in Managua (headquarters for Honduras and Nicaragua) and increased circulation of locally printed newspapers, books and magazines.

No Pulp Made in Venezuela

Paper manufacturing activity in Venezuela is entirely dependent on foreign sources of raw materials as there are no pulp producing mills in the country, according to a report to the Department of Commerce. Investigations have been made to determine the feasibility of installing such a plant but scattered forest resources are so isolated from transportation facilities and the market for the types of pulp which such a plant could produce is so limited that prospects so far are not encouraging.

Paper manufactures are confined to wrapping paper, paper bags for cement, et cetera, and small quantities of container board for packaging bottles.

Reduces Quotas of Light Newsprint

The War Production Board last week reduced consumption quotas of 30-pound newsprint for newspapers.

In order to equalize the usage of print paper lighter than 32 pounds, Newspaper Limitation Order L-240 was amended to require a reduction of 6⅔% of the tonnage of all such newsprint ordered after July 1, 1944, officials of the WPB Printing and Publishing Division said. This provision eliminates the yardage advantage gained by users of 30-pound newsprint.

Procedure in the adjustment of light-weight paper consumption quotas requires that:

Beginning July 1, 1944, if a publisher orders print paper lighter than 32-pound basis weight, his consumption quota for the current calendar quarter shall be reduced proportionally as follows: First, determine the percentage by which 32-pound paper exceeds such lighter paper in weight. Second, multiply the tonnage of lighter paper so ordered by this percentage. Third, subtract the result from the publisher's consumption quota. For example, if a publisher has a consumption quota of 200 tons and orders 100 tons of 30-pound basis weight paper, his consumption quota shall be reduced by 6⅔ tons, since 32-pound paper is 6⅔% heavier than 30-pound paper.

Another amendment to the newspaper order provides permission to borrow sufficient newsprint tonnage from the first quarter of 1945 to take care of the fourteenth Sunday issue in the fourth quarter of 1944. It was explained that as there are 14 Sundays in the fourth quarter of 1944, but only 12 Sundays in the first quarter of 1945, the permitted borrowing of tonnage evens up consumption.

Other amendments peg the consumption of paper by special types of newspapers and small newspapers, WPB officials said.

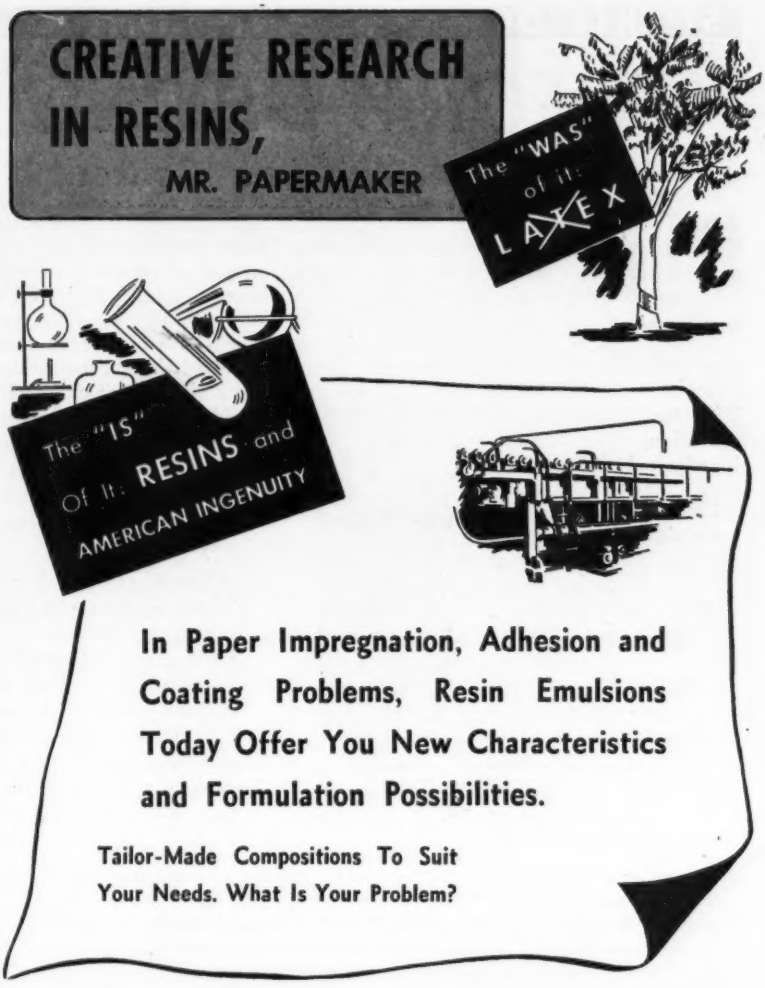
Beginning October 1, 1944, the quarterly consumption of newsprint by special types of newspapers and newspapers using less than 25 tons per quarter is frozen at the average quarterly consumption in the first three quarters of 1944, or the consumption in the corresponding calendar quarter of 1943, whichever is the greater. The exception providing for additional tonnage to cover copies for sale to the armed services personnel has been pegged at the level of consumption during the first three quarters of 1944 or the corresponding calender quarter of 1943, whichever is greater.

Free-distribution newspapers in existence in 1941 will continue under Schedule II of the Commercial Printing Order L-241, even though they may have changed to a partial or fully net paid basis, Printing and Publishing Division officials explained.

A provision that print paper shipped by water need not be added to or included in a publisher's inventory until it is actually delivered to him is covered in another amendment effective today.

Publishers of small newspapers may use 1¼ tons of print paper per weekly issue during any calendar quarter under the amended order. This means that any such publisher, whether or not he used any paper in a previous period, may use 1¼ tons per quarter for a weekly issue, 2½ tons for a semi-weekly issue, or 7½ tons for a newspaper issued six times a week.

A further amendment to Order L-240 permits newspaper publishers to fill their monthly delivery quotas, irrespective of the amount of print paper in inventories, provided they do not exceed the present allowable inventory ceiling on December 31, 1944.


CREATIVE RESEARCH IN RESINS,
MR. PAPERMAKER
The "WAS" of it: LATEX
The "IS" Of It: RESINS and AMERICAN INGENUITY
In Paper Impregnation, Adhesion and Coating Problems, Resin Emulsions Today Offer You New Characteristics and Formulation Possibilities.
Tailor-Made Compositions To Suit Your Needs. What Is Your Problem?
American Resinous Chemicals Corp.
HOME OFFICES AND LABORATORIES:
NEWARK, N. J.
MONROVIA, CALIF.
CHICAGO, ILL.

STICKLE DRAINAGE AND CONTROL

UNIFORM DRYING

with Proper Moisture Content

● Uniform drying with Stickle Equipment means control so positive and so accurate that moisture content can be held within a variation of one-half of one per cent.

Stickle Control combines the tension principle of regulating steam valves with Stickle Thermal Control. In operation, after control is adjusted for the desired moisture content, Stickle Thermal Control maintains the moisture content at the desired point by its action in retarding or accelerating the steam flow as the sheet may become too dry or too wet.

In other words, when variation in weight, free or slow stock, affects tension control, resulting in a sheet either too dry or too wet, Stickle Thermal Control automatically eases the situation by retarding momentarily, the natural action of tension control, which allows the thin or thick section in the sheet to pass across the roll at the weighted moisture content. However, should the sheet continue on the lighter or heavier side, tension control and thermal control act together and either retard or increase the steam flow as the drying conditions may demand.

Stickle Visible Micro Adjustable Orifice. Supplied with or without indicating thermometer.

Results are: (1) Stabilization of steam flow resulting in a more uniform product. (2) Elimination of manual control to greatest possible degree. (3) Steam saving by checking over-heating of driers. (4) A better dried and a better quality sheet.

This is one of many advantages that has made Stickle Drainage and Control System the choice of the paper industry. Among other advantages afforded by the complete Stickle System are: Stabilized Steam Flow; Close Control of Moisture Content; Correct Drainage at all pressures; Visible Operation of each syphon; Improved Quality of product; Economy of Steam—greater tonnage in ratio to steam used; Increased Boiler Capacity; Reduced Fuel Costs; and Higher Production Capacity—increased speed of machines.

Stickle

STEAM SPECIALTIES COMPANY

2245 VALLEY AVENUE • INDIANAPOLIS, INDIANA

FOR 40 YEARS REDUCING STEAM COSTS IN PAPER MILLS

Lacquer Cost Reduced

An important reduction in the cost of lacquer applications has been made in Hercules Powder Company laboratories, according to a paper given by William Koch, before the Division of Paint, Varnish, and Plastics Chemistry at the meeting of the American Chemical Society in New York City, September 14.

The reduction in cost is obtained through a saving in solvent and a reduction in the number of finishing coats required without sacrificing the recognized high-quality performances of nitro-cellulose lacquers.

The saving in solvent and the reduction in the number of finishing coats is a result of using nitrocellulose lacquers of increased solids content at spraying viscosity, according to Mr. Koch's report.

Data were presented which demonstrated that the solids content in nitrocellulose lacquers can be increased by using lower-viscosity type nitrocelluloses and larger proportions of nonoxidizing alkyd resins with either a more active solvent or by applying the lacquer by a hot-spray method.

The results obtained by using each method were cumulative when two or more were used at the same time. The greatest increase in solids content is possible only when two or more methods are used.

Four nitrocelluloses of standard types well known to the trade were used in the tests.

Percentage increase in solids content ranged as high as 114% in one instance. This was accomplished through a combination of the four methods of increasing the solids content.

Nitrocellulose lacquers have been widely used for many years because of properties such as rapid drying to a hard film without the necessity of baking, good resistance to temperature change, hardness which makes lacquers resistant to scuffing and printing, ease of finishing, and formation of pleasing and weather-resistant films.

The new methods of increasing the solids content are expected to further enhance the value of using nitrocellulose lacquers in industries such as automobile and furniture. This new development may also become important in the coating of cloth and paper.

Eire's Paper Consumption

Annual consumption of paper in Eire is reportedly 65,000 tons, of which a little more than 1/5 is produced locally, according to a report to the Department of Commerce. By various ingenious devices, for instance, utilizing straw, local paper manufacture has been increased by about 12%.

In pre-war years, Eire imported approximately 53,000 tons of paper, but at present only 10,000 tons are imported. Limited quantities of this product have been obtained from Canada and Sweden, but war-time shipping difficulties have curtailed the amounts that can be imported.

Doubles Paper Output

Productive capacity of Argentina's paper industry has been more than doubled since 1939 and mills are now equipped to supply roughly two-thirds of the country's requirements, says a report to the Department of Commerce.

The only mass-produced items which Argentina must still import on a large scale are newsprint, heavy wrapping paper for cement and similar types of bags, and book paper.

TRADITIONALLY PREFERRED FOR PRECISION PRINTING PRODUCTION

The great Northwest was won by pioneers fortified by courage, conviction and intelligent effort. These essential characteristics are also found in business organizations that have long pioneered in the unending quest for perfection of products. Many years have passed since The Northwest Paper Company, at its origin, embarked upon such a course. This period has been marked by mileposts of achievement in serving the Nation's paper users. Our creed to "serve best with the best" is assurance to you that Northwest Papers will continue to be America's greatest paper values.

Buy more War Bonds to hasten V-Day

VICTORY *War Quality* PAPERS

THE NORTHWEST PAPER COMPANY · CLOQUET, MINNESOTA

PAPER
TRADE JOURNAL
Title Reg. U. S. Pat. Off.
Henry J. Berger, Editor

COMING EVENTS IN PAPER INDUSTRY

NEW ENGLAND SECTION. Technical Association of the Pulp and Paper Industry—Third Friday of each month at the Roger Smith Hotel, Holyoke, Mass.

DELAWARE VALLEY SECTION. Technical Association of the Pulp and Paper Industry—First Friday of each month at the Engineers Club, Philadelphia, Pa.

LAKE STATES SECTION. Technical Association of the Pulp and Paper Industry—Second Tuesday of each month at the Conway Hotel, Appleton, Wis.

KALAMAZOO VALLEY SECTION. Technical Association of the Pulp and Paper Industry—First Thursday of each month at the Park, American Hotel, Kalamazoo, Mich.

CHICAGO PROFESSIONAL PAPER GROUP—First Monday of each month except July and August at Chicago, Ill.

IMPRESSIVE RECORD MADE BY TECHNICAL ASSOCIATION

The Technical Association of the Pulp and Paper Industry for the first time in its history of over a quarter of a century will not hold its annual fall meeting this year. Normally the recreational feature is emphasized at this meeting, whereas at the annual meeting in February an educational program more especially is carried out. During the past several years, however, the fall meeting has assumed such serious importance that this step was taken reluctantly and only after it had been ascertained that it met with the approval of a great majority of the membership. The omission of the meeting is, of course, in accord with the feeling of the Government that meetings of associations not absolutely necessary to the conduct of the war should be abandoned.

The PAPER TRADE JOURNAL, which has been in the habit of covering the annual fall meeting at considerable length in special issues which it believes have been really valuable contribution to the literature of the industry, was reluctant to omit this issue this fall and it has, therefore, arranged this current issue which it hopes will serve as an acceptable substitute.

As the Technical Association is conducted with little regard to publicizing its activities, this number and this time seem opportune to print rather fully the record of what the organization has been doing in times of peace to promote the development of the technical side of pulp and paper making and in times of war to promote the winning of the peace by cooperating with the Government in supplying its pulp, paper and paperboard requirements.

This record of the Technical Association of the Pulp and Paper Industry is an impressive one. Few of the great industries are served as well and none are served better from the technical side than TAPPI serves the paper industry.

An outstanding illustration of this fact is the Bibliography of Paper Making which has been prepared annually for a long number of years by Dr. Clarence J. West, chairman of the Abstracts and Bibliography Committee of the Technical Association and editor at the Institute of Paper Chemistry, Appleton, Wis. This is an index of the technical literature on the manufacture of pulp and paper from the trade and technical journals printed in this and foreign countries extending back to 1900. Not even the great steel industry has such a complete record of its technical literature. Provided with author and subject indexes, making any article that has been printed anywhere in the world easy to find, the great value of this work is, of course, obvious.

Named among the principal objects of the Technical Association when it was founded was the production and distribution of technical literature. At that time the production of such literature was pathetically meager as any one may observe by consulting the paper publications of that time. In fact, the technical men of that period seemingly suffered so greatly from writer's cramp or, at any rate, from a disinclination to put their thoughts in printed form, that most of the technical matter printed in the American paper trade journals was usually translated from the Swedish, French or German paper publications. In fact, it was a difficult matter when the PAPER TRADE JOURNAL became the organ of the Technical Association to obtain sufficient original matter domestically produced to fill the technical section in the Journal. Under the influence of the association, conditions gradually changed until now in normal years some 600 or 700 pages of matter are printed annually in the technical section.

A helpful influence in promoting the production of technical literature has been the publication of Technical Association Papers, issued each fall by the association. The current issue now in press is the twenty-seventh series and will make an impressive volume of 836 pages. As the subtitle of the book states it is a record of the technical developments in the pulp and paper and related industries for the year.

Space, unfortunately, does not permit of additional references here to the outstanding accomplishments of the Technical Association, but they are told in the leading article in this issue and furnish a list of which the association may well be proud.

The Technical Association of the Pulp and Paper Industry has been fortunate in the men it has selected as officers. They have usually been men of high caliber who have applied themselves diligently to promoting the best interests of the association.

The association has been especially fortunate in securing capable men to fill the important office of secretary-treasurer. This statement is sufficiently substantiated by the fact that the association in its long life has been served by only three secretary-treasurers.

All the older members of the association pleasantly remember the late Thomas J. Keenan who served as secretary of the association from its organization in 1915 until 1921.

William G. MacNaughton succeeded to the office in 1921 under the presidency of George E. Williamson and the year in which the PAPER TRADE JOURNAL

became connected with the association. Mr. MacNaughton did a commendable job and, when he resigned in 1927 to reenter the engineering field of the industry, his departure was greatly regretted.

R. G. Macdonald became secretary in 1927 under the presidency of E. C. Tucker. He has, therefore, served the association in this important office for sixteen years during which time the association has constantly prospered and gained in size, in influence and in prestige. It was undoubtedly due to his peculiar fitness and unusual qualifications for his position that the Army and Navy were influenced to turn to TAPPI as a trustworthy and efficient cooperator in solving their many, varied and important war time problems regarding paper. Mr. Macdonald has done a splendid job.

TAPPI now has over two thousand individual members and in addition several hundred members are carried on its roster under the category of corporate and sustaining members. This remarkable membership attests to the high regard in which the association is held not only in this country but throughout the world wherever the making of pulp and paper is an important industry.

The Technical Association of the Pulp and Paper Industry is in a sound position in every respect. It is intelligently and efficiently directed and it will continue to serve the pulp and paper industry even more effectively and satisfactorily during the critical post-war period, which is rapidly approaching, than it has in the past.

Production Ratio Report*

(Production as per cent of six-day capacity)

COMPARATIVE WEEKLY SUMMARIES

Current Weeks—1944		Corresponding Weeks—1943	
July 29	92.7	July 31	90.8
August 5	90.7	August 7	89.5
August 12	93.0	August 14	92.4
August 19	91.3	August 21	90.9
August 26	93.2	August 28	91.2
September 2	*92.8*	September 4	90.7

COMPARATIVE MONTHLY SUMMARIES

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Avg.
1943	87.2	88.9	89.5	88.7	91.4	84.8	84.3	91.0	88.3	89.6	89.6	82.0	87.8
1944	89.6	89.6	89.2	88.8	89.7	92.6	81.7	*92.5*					

COMPARATIVE YEARLY SUMMARIES

	1937	1938	1939	1940	1941	1942	1943	1944
Year to Date	86.9	69.0	78.9	86.7	94.2	93.2	88.2	*89.6*
Year Average	79.8	71.5	83.4	85.6	97.4	90.4	87.8	

*Based on tonnage reported to American Paper and Pulp Association. Does not include mills reporting to National Paperboard Association, except in isolated cases where both paper and paperboard are produced and separate tonnage figures are not readily available. Does not include mills producing newsprint exclusively.

PAPERBOARD OPERATING RATIOS†

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year Avg.
1938	56	63	63	60	60	59	59	69	70	73	67	61	64
1939	65	73	76	74	69	73	68	77	82	91	88	77	77
1940	78	75	74	76	82	85	77	79	78	85	83	77	78
1941	81	88	89	89	91	94	92	98	95	99	98	90	92
1942	102	101	101	95	82	72	68	75	76	81	82	77	84
1943	86	88	94	94	96	94	89	96	94	94	93	87	93
1944	90	96	95	96	96	96	85	*96*					

Week ending July 29, 1944—96
Week ending Aug. 5, 1944—96
Week ending Aug. 12, 1944—96
Week ending Aug. 19, 1944—95
Week ending Aug. 26, 1944—96
Week ending Sep. 2, 1944—97

†Per cents of operation based on "Inch-Hours" reported to the National Paperboard Assn.

Goes With Penn Paper & Stock Co.

Charles M. Mead has become associated with the Penn Paper and Stock Company, 910 Brown street, Philadelphia 23, Pa. Mr. Mead began his new duties August 1, 1944.

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- Grocery and Shopping Bags
- Multiwall Shipping Bags for Heavy Duty
- Cartons and Carton Liners
- Liners for Crates and Barrels (plain and laminated)
- Moist-Product Containers (frozen foods, potatoes)
- Shipping Labels and Tags
- "Wet-Scuff" Resistant Boxes and Bags
- Maps and Blueprint Papers
- Photographs
- Direct Process Prints
- Towels, Facial Tissues and Handkerchiefs
- Hanging Papers
- Twisting Papers
- Inner & outer plies only of paper board for use under moist conditions
- Papers for dry use where maximum fold is required
- Thin papers where good sizing is difficult
- Wipers replacing rags
- Outdoor Advertising
- Papers exhibiting minimum dimensional change with humidity variations.

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122 E. 42nd St., New York 17, N. Y.
Edited by R. G. Macdonald, Secretary

Study of the Dissipation of the Frictional Heat in the Mechanical Process*

By J. C. Jaeger[1] and J. L. Somerville[2]

Abstract

A theoretical study has been made of the temperatures reached at the grinding surfaces in the mechanical pulping process and of the distribution of the heat developed by grinding between the wood and the stone. An exact solution of the general problem is obtained, by mathematical analysis, for a simplified model, and this is used to justify a simpler mathematical treatment which gives approximately the cyclic changes of temperature of any point on the grinding surface of the stone during a complete revolution. This treatment takes into consideration the effects of (1) conduction of heat into the wood, (2) cooling of the stone by the top shower and stock in the pit and (3) water carried into the grinding areas by the grooves in the stone surface. It is found that the working temperature reached by the stone, under normal steady operating conditions, is higher than the temperature of the stock in the pit. Observation of the difference enables an estimate to be made of the cooling effect at the grinding interface. It is concluded that water is always present at the interface as a liquid film between the surfaces. The temperature of the surfaces under normal and abnormal operating conditions is discussed, as well as the cyclical fluctuation of the temperature of the stone at the surface and at shallow depths.

In the study of the production of pulp by the mechanical process, one of the most important fundamental results is that obtained by Edwards, Jones, Potter, and Johnston *(1)* who found that the frictional heat developed at the interface between pulpstone and wood is nearly the full equivalent of the energy used in driving the stone and that a very small amount of energy is absorbed in forming new surfaces when fibers are separated from the wood. The work described in the present paper continues from this point by examining quantitatively the process of dissipation and absorption of the heat developed at the grinding surface.

At the place where grinding is being done, between the wood and the revolving stone, the lands left by the burr pattern on the stone are in intimate contact with the wood surface and one can expect that heat will tend to flow into the stone. At the same time heat will tend to flow into the wood and heat will also be absorbed by the water and fiber which is carried round by the stone underneath the wood being ground. One has, therefore, to study the mechanism of the transfer of heat between the various elements of this system and of the flow of heat from its source at the grinding surface towards the stock in the grinder pit.

The problem outlined above is a difficult one, both because very few quantities are observable, and because the amount and effect of the water carried round with the stone are unknown. The known facts and observable quantities are as follows: (1) almost the whole of the energy supplied to the grinder appears as heat in the stock in the grinder pit; (2) the temperature of this stock is determined by measurement of the splash from the stone; this may be taken to be the surface temperature of the stone when leaving the stock in the pit; (3) the amount of heat removed in the top shower can be determined since the rate of flow of water in the shower and its average temperatures when entering the shower and leaving the stone can be measured; (4) the average temperature of the stone can be measured.

1. Grinder System

The calculations made below are based upon the performance of a "Great Northern" grinder using natural stones and grinding eucalyptus wood *(E. regnans)*. The radius of the stone is taken as 79 cm. and its length as 137 cm. The power absorbed by the stone is 1000 kw. and it revolves at 238 r.p.m. The thermal constants taken are those for natural sandstone given by usual reference books. They are: conductivity, $K = 0.005$, specific heat, $c = 0.18$, density, $\zeta = 2.2$, diffusivity, $\mathrm{K} = K/\delta c = 0.013$. Units are c.g.s. and degrees C throughout.

The system taken for the grinder is that shown diagrammatically in Fig. 1. AB and DE are the two pockets, FG the region where the stone dips into the stock, and CD the region in which the top shower water is in contact with the stone.

The general problem is so complicated that to make the role of heat conduction in the stone clear and to justify the elementary approximate treatment given in sections 3 and 5 we first neglect grooving of the stone, water carried round with the stone, and conduction of heat through the wood. For this case the

* This paper is a special contribution to the TAPPI Number of the Paper Trade Journal.
[1] Lecturer in Mathematics, University of Tasmania.
[2] Member TAPPI; Chief Chemist, Australian Newsprint Mills Pty. Ltd., Boyer, Tasmania.

problem can be solved exactly and the exact solution is discussed in section 2. In section 3 a simple approximate treatment of the same idealized problem is given and the results of this are found to agree so well with those of the exact theory of section 2 that we are justified in extending the approximate theory in an attempt to discuss the effect of water carried round with the stone; this is done in section 5. The effect of conduction of heat in the wood is examined briefly in section 4.

2. The Exact Solution For A Simple Model

The simple model first considered is that of a rotating cylinder on to which wood is pressed uniformly in the pockets AB and DE so that heat is generated at a uniform rate of Q calories per unit time per unit area over these regions; in the regions BC, EF, GA the loss of heat from the surface of the stone is small and will be taken to be zero; finally in the regions CD and FG where the surface of the stone is in contact with the top shower or with the stock in the pit its temperature will be approximately constant. We can now see qualitatively the way in which the temperature of a point on the stone varies; as it moves over the wood in the pocket AB its temperature will rise, because of the supply of frictional heat; in the region BC there is no loss of heat from the surface and the temperature of the point will fall by conduction of heat into the interior of the stone; when the point enters the top shower CD the temperature of the point will drop rapidly and then be kept approximately constant; in the second pocket DE the temperature will rise again because of heating by friction; in EF it will fall by conduction of heat into the interior of the stone; in the pit FG it will be approximately constant; and so on, the process repeating cyclically. When the stone is warming up, some heat is used in raising its temperature, but when it has attained its working temperature a steady state will be reached and the surface temperature will oscillate in the way described above about the mean temperature of the stone. The form of these temperature oscillations can be calculated exactly from the data of Fig. 1, provided the ratio between the amounts of heat extracted in the top shower and in the stock in the pit is known: this exact calculation *(6)* is difficult and the results alone will be given here for comparison with those of the approximate method to be described in section 3. The curves of Fig. 2 show these oscillations of temperature for the case in which ¼ of the total heat is removed in CD and ¾ in FG; Curve I represents the surface temperature and curve II that at a depth of 0.5 mm. below the surface. In both cases V/Q, where V is the temperature variation of the point from the mean temperature of the stone, and Q is the number of calories generated per unit time per unit area in the pockets, is plotted against angular distance round the stone from the point A. V/Q, it is to be noted, is a measure of temperature variation also.

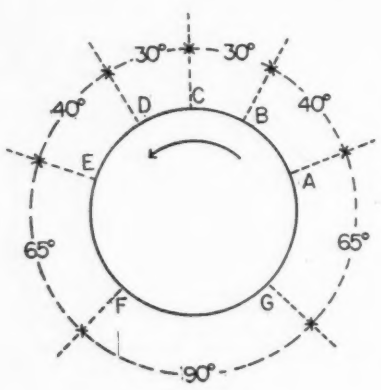

FIG. 1
Diagram of Grinder System

The following conclusions are to be drawn from the curves of Fig. 2: (1) these temperature fluctuations are extremely shallow, (2) the temperature maxima inside the stone are displaced in phase relative to those on the surface because of the time taken for heat to be propagated inwards, (3) the temperatures on the surface and the temperatures inside the stone oscillate about the same mean value, namely the working temperature of the stone, (4) the temperature at G on curve I is the recorded stock temperature in the pit and it is seen that this is considerably below the working temperature of the stone; similarly the maximum temperature attained is considerably above the working temperature of the stone.

3. Approximate Solution of the Problem of Section 2

We now give a simple approximate method which leads to values of the surface temperature which agree very well with those of Fig. 2. Consider any point on the stone: then, with the values given above, it spends the following time in one revolution in each of the different regions:

AB	BC	CD	DE	EF	FG	GA	
0.028	0.021	0.021	0.028	0.0455	0.063	0.0455	seconds

We now neglect conduction of heat sideways, i.e. we suppose the temperature at the point to be that of a long rod, perpendicular to the surface, with insulated sides and with its end in the surface of the stone. Then if we start at zero time with the rod at zero temperature and its end at A, the end is in the region AB for 0.028 seconds and during this time heat is supplied at the end at the rate Q calories per unit time per unit area. At time $t = 0.028$ seconds the end of the rod reaches the region BC and is insulated. A formula for the temperature at the end of the rod under these conditions is given in (1) of the Appendix. From $t = 0.049$ to $t = 0.070$, when the rod is in the top shower, heat is extracted from it in such a way that the end of the rod is kept at approximately constant temperature, and that the total quantity of heat extracted in his region is a known fraction, in this case taken to be ½ as in section 2, of the total heat supplied in the region AB. The solution for the temperature at the end of the rod under these conditions is given in (2) of the Appendix, and must be superposed on the preceding one starting at $t = 0.049$. At $t = 0.070$ the point enters the second pocket DE, and starting at this time another solution of type 1 must be superposed. Finally at $t = 0.1435$, when the point enters the pit, another solution of type 2 must be superposed to extract 3/2 of the heat supplied per pocket. The final result is shown in Fig. 3, V/Q being plotted against angle, where V is the temperature at the end of the rod. This process if continued indefinitely would give a periodic curve like that of Fig. 2, that is the ordinates of the curve at the beginning and end would be equal; however, it will be

seen that the departure of the curve of Fig. 3 from its mean value (the dotted line in Fig. 3) agrees very well with the curve of Fig. 2 and accordingly we may take the oscillations about its mean of a curve obtained as in Fig. 3 as representing with sufficient accuracy for our purpose the steady state oscillations of the surface temperature about the working temperature of the stone.

4. The Effect of Conduction of Heat In the Wood

In the treatments of sections 2 and 3 it has been assumed that the wood is a perfect insulator, that is, that the whole of the heat generated is taken up by the stone and that the surface temperature of the stone may be calculated on this basis. This point has been examined *(2)* in connection with the sliding of a contact on a plane surface and it is found that the above assumptions are justified for reasonably high velocities of sliding—those occurring in the present problem are ample.

Thus of the heat generated where wood is in contact with the stone some is conducted through the wood and some passes into the moving stone and is carried along with it. As the speed of sliding increases, the ratio of the amount of heat taken by the wood to that taken by the stone decreases until at fast sliding rates practically all the heat is taken by the stone. Then the surface temperature of the stone (and the wood) tends towards that calculated on the assumption that no heat flows away through the wood, i.e. that the wood is a perfect insulator.

5. The Effect of Water Carried Round With the Stone

We now attempt to extend the elementary treatment of section 3 to take into account the presence of of water on the stone when it is in the pockets. The general picture is that water is present on the grinding face and that there is a convection of heat away from the face with this water, as well as conduction of heat into the stone. The simplest mathematical assumption which approximates to this idea is, that at any point of the stone in contact with the pocket, heat is being generated by friction at the rate of Q per unit time per unit area, and is being removed by convection at a rate per unit time per unit area of M times the difference between the actual and mean surface temperatures, where M is a constant. This mean surface temperature is the same as the working temperature of the stone. This condition would arise,

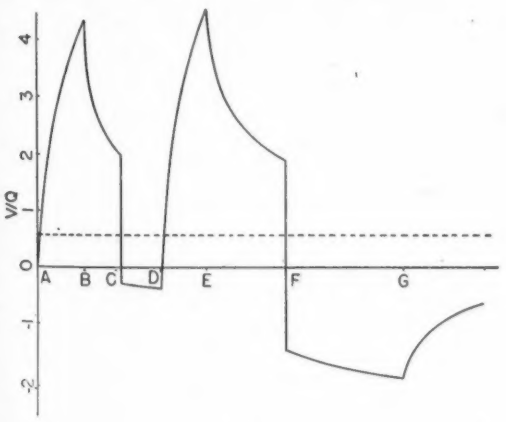

FIG. 2

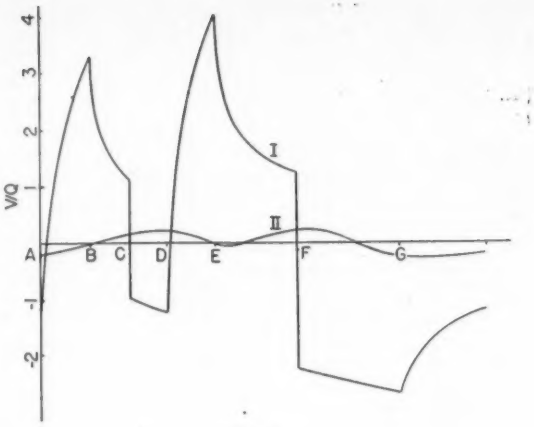

FIG. 3

e.g., if a mass M per unit time per unit area of water of specific heat unity were applied to the grinding surface at the mean temperature and removed at the surface temperature; for this reason to give a simple physical interpretation of the condition we shall speak of and interpret M as a mass of water per unit time per unit area. The solution of the appropriate problem in conduction of heat is given in (4) of the Appendix, and in calculating temperatures by the approximate method of section 3 the only change is that solution 4, with the appropriate value of M, is to replace solution 1, when the point is in the pockets.

To calculate the temperatures we need additional data. First, we shall assume that the lands comprise half the surface of the stone and that they are uniformly in contact with the wood; this assumption enables us to calculate Q, which with the other values given above, is 31.6 calories per sq. cm. per second.

We also need the amount of heat extracted in the top shower. In the grinder in question the flow in the shower was 35 gallons per minute and the difference between its initial and final temperatures was 15°C. Thus about ⅓ of the heat generated per pocket is extracted in the shower; some of this heat, however, will have been derived from the water on the stone, and some from the stone itself. For simplicity we shall assume that half of this, i.e. 1/6 of the heat per pocket is extracted from the stone.

We are now in a position to calculate the surface temperature of the stone for different values of M. Two other quantities may be mentioned which give a scale to these values: (1) If the stone grinds 15 tons of wood per day this is equivalent to a mass of 0.024 gram per sq. cm. per second, and is small compared with the values of M for water which we shall have to take below. (2) If we assume that half the stone surface are lands, that there are four lands per cm., and that the grooves are equilateral triangles, the value of M corresponding to the whole volume of a groove being passed over one land in the 0.028 second during which that land is in the pocket is about 2, so that values of M higher than this are not likely to be encountered.

In Fig. 4 the curves for surface temperature oscillations about the working temperature of the stone are shown for the data given above and the values 0, 0.12, 0.36, 0.6, 1.0 of M. It is seen that for large values of M these temperature oscillations are moderate and that for small values of M they are quite large. The lower values of M will readily give

temperatures well above the boiling point of water and this appears to conflict with the physical interpretation of M given above, i.e. that of a rate of application of water on a unit of area. The curves of Fig. 4 have been calculated, however, for a cooling effect of a given magnitude without regard to the physical interpretation. When it is assumed that water is present and the value of M is small, it will follow that evaporation of much of this water will take place and the curves will stop at the boiling point. Different calculations will then be required to finish the curves. When the curves do not reach the boiling point they stand as shown in the presence of water and there is no difficulty in applying the physical interpretation of M. The matter is discussed further in the next section.

The other important result obtained in these curves is that the difference between the working temperature of the stone and the temperature of the stock in the pit can be used to determine the value of M.

There appear to be, in recent literature, few explicit references to the working temperature. Ruhleman *(3)* made a large number of temperature measurements by a means of thermocouples inserted in the stones. He has paid little attention to the necessity of reaching a steady state and no estimate of the equilibrium working temperature can be obtained from his measurements.

In the present work the temperature was read by means of a base-metal thermocouple pressed firmly on the surface of the stone with a small pad of insulating material, pulp, or cottonwool, held over it. This was done immediately the stone was stopped after a continuous run of several days. A maximum reading of 85°C. was obtained in a few minutes. The thermocouple was calibrated by making readings in the same way in the laboratory with stone heated to 100°C. in a boiling water bath.

Confirmation of these results was sought by examining a stone, which had failed by fracture, as soon as possible after failure. Holes ½ inch in diameter were sunk to depths of about 4, 8, and 14 inches in the center of the grinding face. Temperatures at the bottom of these holes were taken by the aid of oil as a conducting medium and a chemical thermometer and cooling curves at these points were constructed. These are shown in Fig. 5.

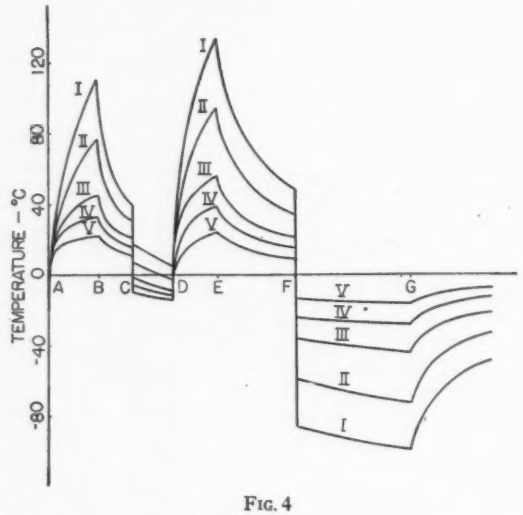

FIG. 4

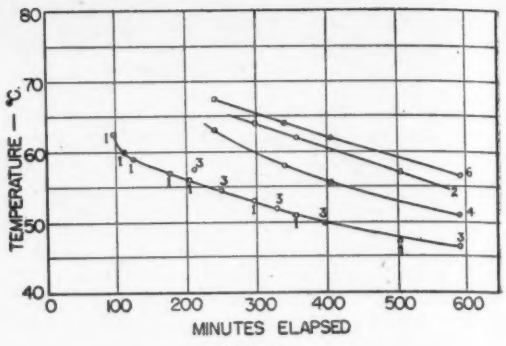

FIG. 5

Temperatures Inside Cooling Pulpstones: 1. Hole 4 Inches Deep, Stone No. 2191; 2. Hole 14 Inches Deep, Stone No. 2191; 3. Hole 4¾ Inches Deep, Stone No. 2187; 4. Hole 13½ Inches Deep, Stone No. 2187; 6. Hole 8 Inches Deep, Stone No. 2187.

Using these cooling curves we have attempted to calculate the initial temperature of the stone (on the assumption that it loses heat at a rate proportional to the temperature difference between its surface and surroundings) by a modification of the method described in Carslaw's "Conduction of Heat," Ed. 2, Sections 63, 66.

The observed points are not sufficiently consistent to give a reliable determination in this way, nor are they continued long enough. However, rejecting the readings from holes numbers 2 and 4, as possibly influenced by loss of heat from the axle hole, and treating the points of the other curves in various ways, we obtain values of the initial temperature ranging between 80° and 85°C. The method also gives values for the outer conductivity and diffusivity of the stone; the fact that these agree very well with results of laboratory experiments that were made on the same sandstone indicates that confidence can be placed in the values of the initial temperatures obtained in this way.

It is seen that one of the temperatures observed in the test holes exceeded, and several closely approached, that of the pit temperature, which was 65° at the time.

6. Conclusions

The general mechanism of the flow of heat in the grinding process is that only a part of the heat generated by friction between the lands of the stone dressing and the surface of the wood is absorbed by the mixture of fiber and water lying in the grooves. The remainder flows into the body of the stone to maintain it at its working temperature which is lower than that attained by the surfaces where the heat is generated. The heat flowing away from the grinder in the stock from the pit is therefore derived in part from the stone, and the temperature of this stock is lower than that of the stone.

Under operating conditions of the grinders being studied, the temperature of the stock in the pit was 66° and that of the stone was 85°. The difference of 19° is that shown in Fig. 4, when M is about equal to 1 gram per sq. cm. per second of water. This result depends on the value taken for Q, the rate at which heat is supplied per unit area of the interface or surface of the land, and Q depends in turn on the proportion the interfacial area bears to the whole stone surface. It is, however, difficult to arrive at a good figure for this proportion, since so much depends on the softness of the wood surface while grind-

ing is going on, and the depth to which the rounded grains which make up the land penetrate into the wood. The estimate made should give the order of magnitude of M for a dull stone surface.

The results obtained for $M = 1$ indicate that the maximum temperature reached by the grinding surfaces is about 100°. When the amount of water carried in the grooves is reduced by, for instance, an accumulation of slivers bearing on the stone, the value of M is lowered and the temperature of the grinding surfaces rises, until, quite early in its passage through the pocket, temperatures of over 100° are reached and water vapor is formed in considerable quantity. The slivers on the stone also interfere with the transfer of heat from the stone and this causes the temperature of the outer layer of the stone to rise and the water in the grooves to evaporate faster and soon M falls to zero and "burning" commences. The surface temperature reached under this condition is calculated to be of the order of 220° at equilibrium, where heat is still being taken freely from the stone in the pit. This transfer will, however, be partly ineffective and the surface temperature will be higher still. The values indicated agree quite well with the temperatures usually taken for the onset of carbonization of wood (250°, 275°). The carbonized wood "glazes" the stone by filling up the grooves. The overheating of the outside layer of the stone may be excessive and a weakening of the structure of the stone can then be expected.

Further conclusions can be drawn from an examination of the results of Fig. 4. It is clearly the presence of water which keeps the surfaces of stone and wood cool, but this is not done simply by the water lying in the groove and being carried round by the stone. If the lands are dry, then any water in the grooves will not be capable of carrying away more than a negligible amount of heat. Under such conditions as this the only heat carried away from the interface as sensible heat will be that in the fibers which are being scraped off. These fibers will give a cooling effect equivalent only to $M = 0.024$ and it can be seen from the results that the temperature of the stone surface at the interface would rise well above the boiling point during the passage of a point through one pocket, and the temperature of the surface of the wood would remain high.

The conclusion reached is that the cooling effect measured by M is performed by water present intimately on the land as a film between the two surfaces. It is, strictly, the cooling effect that is determined by the calculations, and the thickness of water film which will give this effect can be calculated only approximately. The turbulence in the film will be high and the stationary water layers held by the surfaces will be thin, but the resulting effects on the rate at which the film takes up heat is unknown. The presence of the fibrils attached to the surface of the wood fibers will also make some difference to the thickness of the boundary layers and to the turbulence of the moving water in the film.

We can calculate the amount of water carried into a pocket by taking into account the time taken by a point on the stone to traverse the pocket. This time is 0.028 seconds and when $M = 1$ gram per sq. cm. per second the amount of water is 0.028 gram per sq. cm. This water lies mainly in the grooves but some of it is moving on from groove to groove by passing over the tops of the lands and mixing with the water in the grooves again. If we take the width of a land as 1 to 2 mm. then the time of travel of a land over a point on the wood is from 0.00005 to 0.0001 seconds and the amount of water corresponding to $M = 1$ is then 0.00005 to 0.0001 gram per sq. cm. and the film is then 0.0005 to 0.001 mm. thick. This value is only derived in order to show that, while the land cannot be dry, a very thin film is sufficient to give the necessary cooling effect; it is to be emphasized that the calculations are very approximate and that the film thickness obtained is the average of a very variable quantity. This result is not affected by taking into consideration the heat conducted from the surface of the land through the stone to the water lying in the groove. It has already been seen in Fig. 2 what small fluctuations in temperature occur at a depth of 0.5 mm. from the land, and the transfer of heat by this path to the water in the grooves will be negligible.

The question arises how far the processes of fibrillation and the removal of fibers from the wood go on in spite of or because of the presence of this water between the lands and the wood. The high speed of the stone surface will give a large shear in this thin film and this may be sufficient to cause fibrillation and fiber removal. In something like the same way, chemical pulp is beaten when a fiber suspension in water is projected in a jet against a target *(4)*. On the other hand, microscopic projections of the order of some thousandths of a millimeter can be imagined to exist on the surface of the grain forming the land. These would project through the film and tear off the fibrils by contact of dry surfaces, but their life would probably be short and their existence unimportant. There seems but little definite support here for the suggestion made by Brecht and Mueller *(5)* that the total or ordinary coefficient of friction in grinding is the sum of two coefficients, one for the friction of "gliding" and the other for the friction of "scratching" since both actions amount to the transmission of energy through shearing of a water film.

The production of water vapor on a considerable scale which is common in grinders is not incompatible with the above hypothesis. In the calculations the temperature of the lands has been found to rise to about 100° when they are about to leave the end of the pocket. Conditions can easily be imagined which will cause this temperature to be reached earlier in the pocket and from that point on to the end the surface remains hot enough to produce steam from the water film. In the course of vaporization, the heat absorbed is about 530 calories per gram of water, and this is so large compared with the rate at which heat is supplied by the friction at the interface that only a small proportion of the water present will be evaporated. Thus the supply of water can fall well below the value of 0.028 grams per sq. cm. for a while and much vapor will be formed but burning will not occur, and in fact this is often found to happen. All the grinding is done in the presence of liquid water, even if, at the end of the pocket, it is at boiling point. This is true even of those operating conditions where the pit temperature has been raised to the extreme limit practised, say 80°C., since if all the free water carried on the stone surface were evaporated before reaching the end of the passage through the pocket, the dry surface would at least be "blinded" and this condition would soon lead to practical difficulties.

Effects of these temperature relations on the life of the stone under normal conditions remain to be discussed. Of the main type of failure of the surfaces of natural stones that have been observed here, in operation with Great Northern grinders, two seem to be heat effects. One is the formation of planes of weakness parallel to the grinding surface at depths of 2 to 4 inches down in the stone. The other is the formation of rough areas on the surface where the burr pattern is lost and the stone crumbles away for a depth of a few millimeters. There are also what appear to be intermediate states between these two types. Both types develop toward the center and not at the edges of the grinding face.

It can be seen from curve II of Fig. 4 that the fluctuation of temperature at even 0.5 mm. below the surface is small under normal operating conditions and at greater depths it will be negligible. The working temperature of the stone will, however, be lower at the ends by reason of the extra area washed by the stock in the pit, by the conduction of heat through the flange nuts and out by the shaft and also by the localized passage of water from the pit through the stone at this place. The evidence suggests that the extra high working temperature at the center of the grinding face induces chemical action capable on occasion of causing breakdown of the stone structure, but it does not suggest that physical causes alone have any direct effect.

Acknowledgements

We wish to acknowledge the assistance of Mr. A. W. Mackney for the temperature measurements and of Miss M. E. Clarke with the numerical calculations.

Appendix

The following results in conduction of heat have been required above, they are all one-dimensional results for an infinitely long rod $x > O$ with insulated sides. They do not seem to be given explicitly in the literature, but are easily obtained by consideration of the region $x > O$ with prescribed flux at the end $x = O$.

(1) If the region $x > O$ is at zero temperature at time $t = O$ and heat is supplied at the end $x = O$ at the constant rate Q per unit time per unit area for time T, the supply then stopping and the surface $x = O$ being insulated, the temperature at time t at the end $x = O$ is given by

$$\begin{cases} \dfrac{2QK^{\frac{1}{2}}}{K\pi^{\frac{1}{2}}}\, t^{\frac{1}{2}}, \text{ if } O < t < T \\ \dfrac{2QK^{\frac{1}{2}}}{K\pi^{\frac{1}{2}}}\, (t^{\frac{1}{2}} - (t-T)^{\frac{1}{2}}), \text{ if } t > T \end{cases} \tag{1}$$

(2) If the region $x > O$ is at zero temperature at time $t = O$ and heat is supplied at the end $x = O$ at the rate $Q't^{-\frac{1}{2}}$ per unit time per unit area (Q' being a constant) for time T', the supply then stopping and the surface $x = O$ being insulated, the temperature at time t at the end $x = O$ is given by

$$\begin{cases} \dfrac{Q'}{K}\, (K\pi)^{\frac{1}{2}}, \text{ if } O < t < T' \\ \dfrac{2Q'K^{\frac{1}{2}}}{K\pi^{\frac{1}{2}}} \sin^{-1}\, (T'/t)^{\frac{1}{2}}, \text{ if } t > T' \end{cases} \tag{2}$$

and the quantity of heat supplied in the time T' is

$$2Q'T'^{\frac{1}{2}} \tag{3}$$

(3) If the region $x > O$ is at zero temperature at time $t = O$ and heat is supplied at the end $x = O$ at the constant rate Q per unit time per unit area and also heat is removed there at a rate M times the temperature (M being a constant) this process going on for time T after which the end $x = O$ is insulated, the temperature at time t at the end $x = O$ is given by

$$\begin{cases} \dfrac{Q}{M}\left\{1 - e^{\,KM^2t/K^2}\, erfc\, \dfrac{M(Kt)^{\frac{1}{2}}}{K}\right\}, \text{ if } O < t < T \\ \dfrac{GK^{\frac{1}{2}}}{K\pi^{\frac{1}{2}}} \displaystyle\int_0^T \dfrac{du}{(t-u)^{\frac{1}{2}}}\, e^{\,KM^2u/K^2}\, erfc\, \dfrac{M(Ku)^{\frac{1}{2}}}{K}, \\ \qquad \text{if } t > T. \end{cases} \tag{4}$$

where $erfc\ x = 1 - erf\ x = 1 - \dfrac{2}{\sqrt{\pi}} \displaystyle\int_0^x e^{-u^2} du$

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Ethers of Certain Lignin Derivatives*

By Gary M. Jones[1] and F. E. Braun[2]

Abstract

Because of the greater stability and the enhanced hydrophobic nature of ether groups, an investigation has been carried out on lignin ethers which may have a possible application in the manufacture of plastics. A series of mixed methyl ethyl ethers of phenol spruce lignin A were prepared, using diazomethane and diazoethane and dimethyl and diethyl sulphates as alkylating agents. A new procedure for the preparation of lignin ethers is described. The lignin is converted into its sodium salt which, when treated with thallium acetate, gives a thallium salt insoluble in alcohol. This thallium salt reacts with alkyl halides in dimethyldiozane with the formation of the corresponding ethers of lignin. The preparation of the heptyl and benzyl ether of alkali spruce lignin is described.

The water resistance of plastic materials prepared from wood, cellulose, or lignin is undoubtedly affected by the presence of hydroxyl groups which, because of their hydrophilic character, favor water absorption.

* This paper is a special contribution to the TAPPI Number of the Paper Trade Journal.

A portion of a thesis submitted by the junior author in partial fulfillment of the requirements of the Institute of Paper Chemistry for the degree of Master of Science from Lawrence College, Appleton, Wis., June, 1943.

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Plastics manufactured from cellulose esters, ethers, or from molding compounds not containing hydroxyl groups show a much greater water resistance. In order to decrease the hygroscopicity of wood plastics and in this way to improve their water resistance and also their dielectric properties, it would seem advisable to render the hydroxyl groups ineffective by covering them either by esterification or by etherification. Lignin esters have been suggested recently as mold lubricants for wood plastics and it has been found that molding compounds which contain lignin esters show better water resistance than those which consist only of ordinary lignin. Such esters are not very stable, especially at high temperatures and in the presence of water. In view of the greater stability and enhanced hydrophobic nature of ether groups, lignin ethers should be even better than the esters. For this reason, a study of the preparation of certain lignin ethers and their properties was carried out.

A search of the lignin literature showed that there is very little information available concerning the preparation and properties of lignin ethers. The methyl ethers of some lignin preparations have been prepared with diazomethane or with dimethyl sulphate, and appear to be the only ones which have thus far been studied. These methylations have been carried out generally in connection with the study of the structure of lignin. Diazomethane, in the absence of water, will methylate only acid hydroxyl groups such as carboxylic, phenolic, or enolic, whereas dimethyl sulphate will methylate all hydroxyl groups. Willstätter spruce lignin (methoxyl content, 15.5%) has been methylated with diazomethane in cyclohexanol suspension to a methoxyl content of 21.2% which, on further methylation with dimethyl sulphate, was increased to 32.8% *(1)*. Under the same conditions Freudenberg spruce lignin (methoxyl content, 15.3%) gave products with 20.3 and 30.3% methoxyl, respectively *(1)*. Alpha alkali spruce lignin (methoxyl content, 15.45%) and beta alkali spruce lignin (methoxyl content, 14.6%), isolated from an alkali lignin obtained on acidification of a commercial soda black liquor, were methylated with dimethyl sulphate by Holmberg *(2)* to a final methoxyl content of 23.4 and 23.2%, respectively. On the other hand, Marshall *(3)*, on methylation of the alkali spruce lignin fractions with diazomethane, obtained methoxyl contents of 22.2 and 24.8%, respectively; on further methylation with dimethyl sulphate, these values were increased to 31.4 and 28.8%, respectively. On methylation of isolated native spruce lignin with diazomethane, the methoxyl content increased from 14.8 to 21.5% and, on further methylation with dimethyl sulphate, a methoxyl content of 31.3% was reached *(4)*. Phenol lignin from spruce wood has been suggested for the preparation of plastic material *(5)* and, therefore, experiments were carried out on the etherification of phenol lignin A.

Experimental Work

Modified Preparation of Phenol Lignin A

Air-dried sawdust from black spruce (250 grams), previously extracted with alcohol and a mixture of alcohol and benzene (1:1) for 24 hours, was mixed with 2500 grams of anhydrous phenol. To remove the last traces of moisture from the sawdust, approximately 500 ml. of the phenol were distilled off under reduced pressure at a bath temperature of 95° C. The mixture was then cooled and 50 ml. of anhydrous ether containing 5 grams of dry hydrogen chloride were added. The flask was well shaken, whereupon the color of the mixture turned dark purple. The mixture was heated on a water bath to 95 to 98° C. and after a few minutes became quite fluid. After 10 minutes, an additional 50 ml. of anhydrous hydrogen chloride-ether solution were added through a dropping funnel reaching below the surface of the mixture. At the end of 30 minutes of heating, the excess of phenol was distilled off under reduced pressure as far as possible. The black tar-like residue was dissolved in a mixture of dioxane and acetone (1:1), the undissolved cellulose removed by filtration, and the dark brown-violet filtrate concentrated under reduced pressure. The phenol which was left in the residue was distilled off under reduced pressure. The black residue was taken up in about 250 ml. of the dioxane-acetone mixture, the solution centrifuged and filtered, and the crude phenol lignin precipitated by dropping the solution into 12 liters of distilled water which was constantly stirred during the addition. The crude phenol lignin, which separated as a fine light brown powder, was filtered, washed thoroughly with water, and dried in a desiccator over sodium hydroxide and sulphuric acid. It was then dissolved in dioxane, filtered, and reprecipitated by dropping the solution into ether. The insoluble portion, or phenol lignin A, separated as a fine light brown powder and had a methoxyl content of 10.45%. After a second purification the methoxyl content was 10.52%, which compared very well with that (10.4%) found by Buckland *(6)*.

Methylation of Phenol Spruce Lignin A with Diazomethane and Dimethyl Sulphate

These methylations were carried out according to the procedure of Buckland *(6)*. The analytical results are given in Table I (No. 2 and 4).

TABLE I.—ANALYTICAL DATA FOR ETHERS OF PHENOL LIGNIN A

No.	Lignin Compound	Carbon %	Hydrogen %	Alkoxyl %	Number of Alkoxyl Groups: Before Alkoxylation	Number of Alkoxyl Groups: Added by Alkoxylation	Number of Alkoxyl Groups: Total Alkoxyl Groups Present
1	Phenol spruce lignin A	67.24	5.88	10.6	4	..	4
2	1 methylated with CH_2N_2.	70.59	6.42	22.2	4	5.1	9.1
3	1 ethylated with $MeCHN_2$	71.63	7.07	21.3	4	5.2	9.2
4	2 methylated with Me_2SO_4	69.23	6.78	27.1	9.1	2.5	11.6
5	2 ethylated with Et_2SO_4.	70.62	6.94	27.3	9.1	2.8	11.9
6	3 methylated with Me_2SO_4	70.94	7.14	27.1	9.2	3.0	12.2
7	3 ethylated with Et_2SO_4.	73.27	7.62	25.7	9.2	2.8	12.0

CH_2N_2 = diazomethane
Me_2SO_4 = dimethyl sulphate
$MeCHN_2$ = diazoethane
Et_2SO_4 = diethyl sulphate

Ethylation of Phenol Spruce Lignin A with Diazoethane

Because diazoethane could not be prepared by the action of sodium glycolate upon nitrosoethylurethan, a 25% potassium hydroxide solution in methanol was added to a solution of 10 ml. ethyl nitroso-ethylurethan in 110 ml. dry ether and the diazoethane was distilled over with ether. The ethereal diazoethane solution was then added to a 5% phenol lignin solution in dioxane. Ethylation of the lignin was shown by a brisk evolution of nitrogen. The next day the ether was distilled off under reduced pressure and the lignin-dioxane solution retreated with a solution

of diazoethane in ether. After four such ethylations the alkoxyl content was constant. The product was then isolated and purified in the usual manner. The analytical data are given in Table I (No. 3).

Ethylation of Diazomethane-Methylated Phenol Lignin A with Diethyl Sulphate

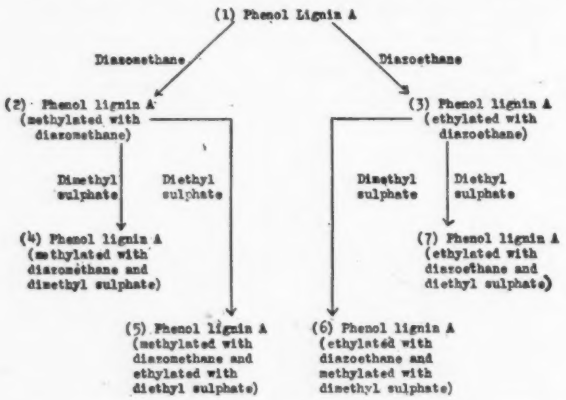
Approximately 3 grams of phenol lignin A, which had been completely methylated with regard to diazomethane (methoxyl content 22.2%), were dissolved in about 75 ml. of acetone and ethylated by simultaneous dropwise addition of 15 ml. of diethyl sulphate and 40 ml. of 30% sodium hydroxide over a period of 2 hours at a temperature of 40 to 42° in such a way that the reaction mixture was always slightly alkaline. At the end of the addition, stirring was continued overnight at room temperature. The next day the acetone was distilled off under reduced pressure, causing the separation of the lignin derivative in a solid form. This was filtered, ground up with water in a mortar, filtered, and thoroughly washed with distilled water to remove inorganic salts.

The product was reethylated in the same manner until a constant alkoxyl content was reached, which usually required five to six alkylations. It was then purified twice by precipitation from its solution in dioxane into anhydrous ether. The analytical data are given in Table I (No. 5). Ethylated, diazomethane-premethylated phenol spruce lignin A is very soluble in benzene, dioxane, and acetone, very slightly soluble in ether, and insoluble in petroleum ether, water, and dilute sodium hydroxide.

Complete Methylation and Complete Ethylation of the Diazoethane Premethylated Phenol Lignin A with Dimethyl Sulphate and Diethyl Sulphate, Respectively

These alkylations were carried out by the method used for the ethylation of the premethylated compound; the products were alkylated until a constant alkoxyl content was obtained. After purifying and drying in an Abderhalden, the products were analyzed with the results given in Table I (Nos. 6 and 7).

The various reactions carried out with phenol lignin A are shown in the following diagram:—


(1) Phenol Lignin A
Diazomethane
Diazoethane
(2) Phenol lignin A (methylated with diazomethane)
(3) Phenol lignin A (ethylated with diazoethane)
Dimethyl sulphate
Diethyl sulphate
Dimethyl sulphate
Diethyl sulphate
(4) Phenol lignin A (methylated with diazomethane and dimethyl sulphate)
(7) Phenol lignin A (ethylated with diazoethane and diethyl sulphate)
(5) Phenol lignin A (methylated with diazomethane and ethylated with diethyl sulphate)
(6) Phenol lignin A (ethylated with diazoethane and methylated with dimethyl sulphate)

Tritylation of Phenol Spruce Lignin A with Triphenylchloromethane

A solution of 5 grams of phenol lignin A in 45 ml. of anhydrous pyridine was treated with 10 grams of triphenylchloromethane and the mixture was swirled until the trityl chloride was completely dissolved. The mixture was heated for 15 minutes on a water bath at 70° C. and then allowed to stand for 48 hours at room temperature. It was then poured onto 300 grams of cracked ice. When the ice had melted, the tritylated lignin was filtered, washed thoroughly with distilled water, and retreated with triphenylchloromethane as before. The product was then isolated and purified in the usual manner. Its methoxyl content was 5.4%, its carbon content 81.24%, and its hydrogen content 5.78%.

Preparation of Lignin Ethers of Higher Alcohols

Certain chemical properties of thallium make this element unusually suitable for a series of chemical reactions which lead to the esterification of acidic hydroxyl groups. Thallous acetate is similar to sodium acetate in that it is very soluble in water and rather soluble in ethyl alcohol. Thallous halides, on the other hand, are similar to silver halides, in that they are very insoluble in almost all solvents. This behavior suggests the possibility of the following reactions (where Lig. refers to the alkali lignin molecule).

(1) Formation of the sodium lignin salt:
$$Lig.OH + NaOH \rightarrow Lig.ONa + H_2O$$
(2) Formation of the thallium salt:*
$$Lig.ONa + CH_3COOTl \rightarrow Lig.OTl + CH_3COONa$$
(3) Formation of the lignin ether:
$$Lig.OTl + RX \rightarrow Lig.OR + TlX$$

* The lignin thallium salt can also be prepared by the addition of an alcoholic solution of thallium alcoholate to an alcoholic solution of lignin.

Preparation of the Thallium Salt of Alkali Lignin

Alkali lignin (10 grams) (methoxyl content 15.5%) was dissolved in 185 ml. of a 0.1277 *N* alcoholic sodium hydroxide solution (two molecules based on a molecular weight of 840 for the lignin) and 75 ml. distilled water. The solution was centrifuged and 0.5 *N* alcoholic thallium acetate was added until all the lignin was precipitated. A total of 500 ml. of thallium solution was required. The precipitate was filtered into a Soxhlet extraction cup and the thallium lignin salt was extracted according to the following schedule: 4 hours with absolute alcohol, 6 hours with dioxane, 2 hours with ether and, finally, 2 hours with petroleum ether. In order to dehydrate the lignin salt, lime was added to the alcohol and barium oxide to the dioxane. The thallium salt was a light yellow-brown powder which contained 32.3% thallium and 10.7% methoxyl.

A suspension of 5 grams of the dry thallium salt of alkali lignin in 50 ml. dimethyldioxane was heated under a reflux with 4 ml. heptyl iodide. After the mixture had been heated for 1 hour at 110° C. no visible reaction was noted. When the temperature of the wax bath was raised to 140 to 160° C. and the mixture had refluxed for about 15 minutes, thallium iodide began to precipitate and the lignin salt started to go into solution, indicating that a reaction was taking place. The mixture was refluxed for 5 hours. It was then centrifuged, the precipitate washed with dimethyldioxane, and the combined solutions filtered. The alkali lignin heptyl ether could be separated into two fractions. By dropping the dioxane solution into ether, the lignin heptyl ether A, insoluble in ether-dimethyldioxane, separated as a reddish brown powder. From the ether dimethyldioxane mother liquor the heptyl ether B was isolated by concentrating the solution and dropping it into petroleum ether (boiling at 60 to 90° C.). It separated

as a dark tan-colored powder. The products were purified in the usual manner and dried at 100° C. in an Abderhalden. The analyses are given in Table II.

The benzyl ether was prepared in a way similar to the heptyl ether and could also be separated into two fractions. Benzyl ether A was a gray-brown and benzyl ether B a light buff-colored powder. Their analyses are given in Table II.

TABLE II.—ANALYSES OF LIGNIN ETHERS

	Carbon	Hydrogen	Methoxyl
Alkali lignin	64.82	5.82	15.5
Heptyl ether A	67.26	6.71	17.3
Heptyl ether B	68.96	6.83	16.5
Benzyl ether A	70.13	5.74	13.4
Benzyl ether B	....	...	12.4

Discussion

Based upon experimental data obtained with phenol lignin, an empirical formula with a molecular weight of 1215.5 and with four methoxyl groups was proposed *(6)*. This formula was based upon the assumption that four phenol molecules reacted with a lignin building unit, that the latter contained five methoxyl groups and that, in the reaction with the phenol, one methoxyl group was split off. When it was found that a lignin building unit of a molecular weight of 840 contained only four methoxyl groups *(4)*, the assumption that one methoxyl group was split off was no longer necessary *(7)*. The molecular weight of phenol lignin A can be calculated by the addition of four phenol molecules to the lignin building unit and the subtraction of one molecule of water, as follows: $840 + (4 \times 94) - 18 = 1198$. The theoretical methoxyl content of this compound is calculated to be 10.36%, which is in satisfactory agreement with that found (10.5%). The number of alkoxyl groups which have entered the phenol lignin molecule in the various alkoxylation experiments can be calculated from the alkoxyl content according to the following equation:

$$(4 \times 31.02) + 31.02n \times 100/MW + n \times a = b$$

in which n is the number of alkoxyl groups introduced, MW is the molecular weight of the lignin derivative, a is the increase in molecular weight caused by the introduction of an alkoxyl group ($CH_2 = 14$ for a methoxyl, $CH_3CH = 28$ for an ethoxyl group) and b is the percentage of alkoxyl found (determined as methoxyl). Column 6 of Table I gives the number of alkoxyl groups originally present, column 7 the number added in the alkylation reaction, and column 8 the total number of alkoxyl groups. Thus, when phenol lignin A (Table I, No. 1) with four original methoxyl groups is ethylated with diazoethane, a partially ethylated phenol spruce lignin A (No. 3) is obtained containing 5.2 ethoxyl groups, giving a total of 9.2 alkoxyl groups. On methylation of this partially ethylated phenol lignin A with dimethyl sulphate and sodium hydroxide, three more methoxyl groups are introduced, giving a completely alkoxylated phenol lignin A (No. 6) with 12.2 alkoxyl groups. Taking into consideration that an error of 0.2% in the methoxyl determination causes a difference of 0.16 alkoxyl group, it can be seen from the table that, on alkoxylation of phenol lignin A with diazomethane or diazoethane, five alkoxyl groups are introduced, indicating that phenol lignin A contains five slightly acid (phenolic or enolic) hydroxyl groups. Further alkylation of the diazoalkyl - alkoxylated phenol derivative with alkyl sulphate causes the introduction of three more alkoxyl groups, indicating the presence of three alcoholic hydroxyl groups capable of alkoxylation. The completely alkoxylated phenol lignin contains twelve alkoxyl groups, which is in very good agreement with the results found by Buckland *(6)*.

Upon the tritylation of phenol lignin A with trityl chloride, a tritylated phenol spruce lignin A is obtained with a methoxyl content of 5.4%. The methoxyl content of a pentatrityl derivative of phenol lignin A is calculated to be 5.15%. The somewhat higher methoxyl value found may indicate that the tritylation is not quite complete. Whether only the five phenolic hydroxyl groups are tritylated or only a part of them, together with some alcoholic hydroxyl groups, cannot be decided without further investigation which is in progress.

The number of thallium atoms which have entered the alkali lignin building unit can be calculated from its thallium content according to the following equation: $204n \times 100/840 + 204n = 32.3$. From this it is found that 1.97 thallium atoms have entered the lignin building unit. The theoretical methoxyl content of the thallium alkali lignin containing two thallium atoms is calculated to be 9.95%. The higher value found (10.7%) results from the fact that the alkali lignin used had a somewhat higher methoxyl content than that calculated for four methoxyl groups in a lignin building unit of a molecular weight of 840 *(8)*. Because the heptyl group gives a quantitative yield of the apparent methoxyl content, under the conditions of the methoxyl determination it is impossible to calculate the number of heptyl groups which have been introduced; however, it is obvious from the increased carbon and hydrogen contents of the two heptyl ethers, as compared with those of the original alkali lignin, that heptyl groups have entered the lignin molecule and that the dioxane-ether soluble fraction contains more heptyl groups than the ether-insoluble fraction. Since benzyl iodide decomposes on heating at atmospheric pressure and does not give an apparent methoxyl content, the numbers of benzyl groups which have entered the lignin can be calculated according to the following equation: $4 \times 31.02 \times 100/840 + 90n = b$, in which n is the number of benzyl groups of molecular weight $C_6H_5CH_2$, 91) and b is the found methoxyl content. In making this calculation, it is found that, in the benzyl ether A 0.96 benzyl group and in benzyl ether B, 1.8 benzyl groups have been introduced into the lignin building unit. The calculated methoxyl contents for the two benzyl ethers on the basis of the introduction of one and two benzyl groups, respectively, are 13.3% for lignin benzyl ether A and 12.2% for benzyl ether B, which agree quite well with the found values. The high carbon content of the benzyl ether also indicates that the benzyl group, which possesses a higher carbon content than the alkali lignin, has entered the lignin molecule.

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September 14, 1944

Effect of Stepwise Bleaching on the Properties of Pulps*

By Pasquale A. Forni[1]

Abstract

The following data support, in general, the commonly accepted view that the bleaching process takes place essentially in three phases. However, they permit a more detailed characterization of these phases, as follows:

I. The first phase occurs in the range of 0 to 20% of the bleach demand and may be characterized as follows: (1) There is no appreciable removal of the lignin. (2) The lignin is chlorinated and subsequently oxidized. (3) There is a sharp increase in absorption coefficient and opacity and a decrease in brightness. (4) There is a geenral increase in the scattering coefficient. (5) The tearing strength increases markedly, reaching a maximum at the end of this phase; the bursting strength shows a corresponding decrease in value.

II. The second phase occurs in the range between 20 and 80% of the bleach demand and is characterized as follows: (1) There is a rapid removal of lignin. (2) There is a decrease in the degree of chlorination of the lignin remaining in the pulp to a zero value. (3) The lignin content shows a linear relationship with the permanganate number and with the absorption coefficient. (4) There is a linear relationship between the brightness increase and the increase in the amount of bleaching agent added. (5) The tearing strength decreases and the bursting strength increases to normal values. (6) The degree of degradation, as measured by the alpha-cellulose content and the physical properties, is slight.

III. The third phase occurs in the range of 80% of the bleach demand to the over-bleached (110%) condition and may be characterized as follows: (1) It becomes increasingly difficult to remove lignin and to increase the brightness. (2) The pulp degradation becomes appreciable. (3) The linear relationship between the lignin content and the absorption coefficient also exists in this phase. (4) Strength properties decrease appreciably.

In the bleaching of pulp, little attention has been paid to the lower ranges of the process, because the results of such studies would have little practical value as far as the brightness of the pulp is concerned. However, from a fundamental point of view, it would seem desirable to investigate the bleaching operation over its entire range, equal emphasis being placed on the reactions occurring during the early and the final stages of the process. Therefore, a study has been made of the various effects of the bleaching agent—physical, chemical, and optical—in a stepwise manner from the unbleached to the completely bleached product. This was done by treating a spruce sulphite pulp with increasing amounts of calcium hypochlorite bleac' liquor until the full bleach requirement of the pulp was satisfied.

The results may be considered under three headings: The effect of the stepwise bleaching procedure on the chemical constants of the pulp, on the physical properties of the pulp, and on the optical characteristics of the pulp. Although two pulps were studied, data are reported only for a book spruce sulphite pulp.

Bleaching Procedure

In this study it was desirable to obtain a uniform bleaching action by a thorough distribution of the bleaching liquor throughout the pulp. Such uniformity is very important where small amounts of bleach are added to relatively large masses of pulp. Therefore, the following standard procedure was followed.

A sample of 250 grams of pulp (moisture-free basis) was bleached at 6% consistency and a temperature of 30°C. The pH was maintained above 8 (by the addition of dilute alkali, if necessary). The unbleached pulp was mixed with two-thirds the required amount of distilled water (at 32°C.) by means of a Hobart dough mixer for 10 minutes at the low speed. The bleach liquor (dilute with half the remaining water) was then added slowly to the pulp with stirring. The receptacle containing the bleach liquor was washed with the remaining water, which was added to the pulp suspension. The bleach liquid was thoroughly blended with the pulp by stirring for 3 minutes (including the time required for the addition of the bleach liquor). At the end of this period, the pulp-bleach mixture was transferred to a porcelain-lined pail and placed in a constant temperature bath at 30°C. The rate of exhaustion was tested with potassium iodide-starch paper.

The permanganate number of the pulp used was 8.8, indicating a requirement of approximately 82.8 pounds of chlorine (in the form of calcium hypochlorite) per ton of pulp to bleach it to a good commercial white in a single-stage operation. As an arbitrary value, 80 pounds of chlorine per ton of pulp was chosen as the 100% bleach demand. The pulp was bleached with 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, and 100% of the total bleach demand of the pulp. These values should not be confused with the percentage of bleaching agent calculated on the weight of the pulp—they actually represent a fraction of the bleach requirement of the pulp. The time to exhaustion is given in Table I.

TABLE I.—TIME TO EXHAUSTION

Percentage of Bleach Demand	Chlorine added, g.*	Time to Exhaustion, min.
10	1.0	3
15	1.5	7
20	2.0	10
25	2.5	22
30	3.0	38
40	4.0	65
50	5.0	130
60	6.0	215
70	7.0	360
80	8.0	450
90	9.0	570
110	11.0	1260

* Chlorine per 250 grams of pulp in the form of calcium hypochlorite.

This paper is a special contribution to the TAPPI number of the Paper Trade Journal.

* A portion of a thesis submitted in partial fulfillment of the requirements of The Institute of Paper Chemistry for the degree of Doctor of Philosophy from Lawrence College, Appleton, Wis., May, 1943.

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The data show that the time to exhaustion is very short for the low percentages of bleach and rises gradually (as the amount of bleach is increased) to about 200 minutes. Beyond this point, the time to reach exhaustion increases rapidly.

Effect on Chemical Constants

The effect of bleaching on the chemical constants of the pulp is shown in Table II.

TABLE II.—EFFECT OF BLEACHING ON CHEMICAL CONSTANTS

Bleach Demand, %	Alpha-Cellulose, %	Beta- and Gamma-Cellulose, %	Lignin Content, %	Ash Content, %
0	83.4	14.28	1.96	0.36
10	83.25	14.45	1.95	0.35
20	83.1	14.66	1.85	0.39
30	82.95	15.06	1.51	0.48
50	82.7	15.96	0.82	0.52
70	82.4	16.60	0.50	0.50
90	82.1	17.52	...	0.38
110	81.4	18.41	...	0.59

Alpha-Cellulose

The data on the alpha-cellulose content showed that some degradation was caused by the calcium hypochlorite bleaching agent when the pulp was bleached to a commercial white. The extent of this action was slight, however, under the conditions used unless more than 100% bleach demand was added. The results indicate that the alpha-cellulose content decreased at a uniform but slow rate to the point where the pulp had been bleached by 100% of the bleach requirement; further bleaching action caused a more rapid decrease in alpha-cellulose.

The data show, therefore, that stepwise bleaching causes degradation of the pulp at a slow rate when the amount of bleaching agent used is within the total bleach requirement of the pulp. If more than this amount is used, the degradation seems to increase appreciably.

The data for lignin (Table II) indicate that actual removal of this component of the pulp did not occur

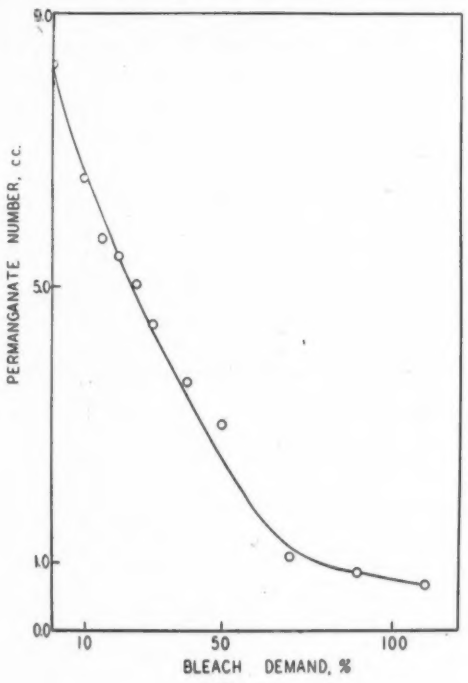

FIG. 1

Effect of Bleaching on the Permanganate Number

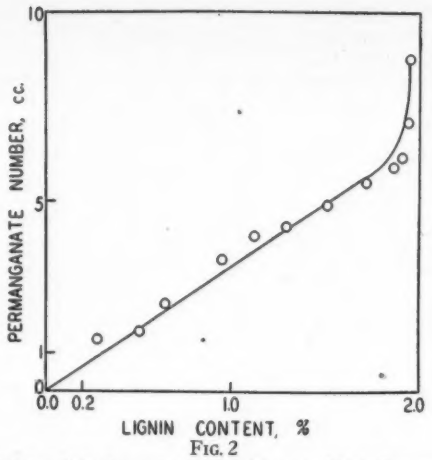

FIG. 2

Relation of the Permanganate Number to the Lignin Content

in the low ranges of bleaching until 20% of the total bleach requirement of the pulp had been consumed. On further addition of bleach, the lignin content dropped sharply until the 70% bleach point was reached. However, in the high-white region, it is increasingly difficult to remove the small quantities of lignin remaining in the pulp.

Chlorination of Lignin

The degree to which the lignin in the pulp was chlorinated was determined by the method of Larson *(1)*. The data are given in Table III.

TABLE III.—EFFECT OF BLEACHING ON DEGREE OF CHLORINATION OF LIGNIN

Bleach Demand %	Degree of Chlorination, %
0	0.00
10	3.38
15	4.00
20	4.62
25	3.75
30	3.31
50	0.95
80	0.00

The data show that one of the first functions of the bleaching agent is to chlorinate the lignin present and that the maximum chlorination occurs with the use of 20% of the bleach demand. After the completion of this first phase, that portion of the lignin which has been chlorinated to the highest degree is removed more easily, as is evidenced by the decrease in the degree of chlorination of the lignin remaining in the pulp.

Permanganate Number

The decrease in permanganate number with increasing bleach addition is shown in Table IV and Fig. 1. There was a very rapid decrease to the point where the pulp had been bleached to 70% of its bleach

TABLE IV.—EFFECT OF BLEACHING ON THE PERMANGANATE NUMBER

Bleach Demand, %	Permanganate Number*
0	8.80
10	7.09
15	6.20
20	5.95
25	5.55
30	4.95
40	4.10
50	3.50
70	1.60
90	1.40
110	1.20

* The permanganate number is expressed as the ml. of 0.1 *N* potassium permanganate per gram of moisture-free pulp.

demand. Beyond this point, the very low permanganate number showed little change with increasing bleaching action.

The relation between the permanganate number and the lignin content of the pulp is shown in Fig. 2. Paradoxically, the trend shows that, at the beginning of bleaching, the bleachability of the pulp, as evaluated by the permanganate number decreases rapidly, although the lignin content is not affected appreciably. This decrease in permanganate number occurs in the region where the lignin is being changed chemically, although its content remains unchanged. The sudden drop in the permanganate number would indicate that the lignin, in addition to undergoing a chlorination, is being oxidized to an appreciable extent, because the negligible extraction of lignin in this region cannot account for the large drop in permanganate number. However, at about 20% bleach, where the lignin begins to dissolve, the permanganate number decreases with the lignin content in a straight line function passing through the origin. Thus, it may be concluded that the permanganate number is inadequate as a means for indicating the lignin content of a pulp when it is partially bleached with small amounts of a bleaching agent. Beyond the 20% bleach demand, the permanganate number would seem to be a valid indication of the lignin content.

Effect on Physical Properties

The freeness of bleached pulps was not affected appreciably by bleaching, except in the case of highly bleached samples. Apparently, the highly bleached samples were in a condition which "developed" easily on beating, so that the stirring action in the British disintegrator, although slight, was sufficient to cause the slight decrease in freeness observed.

TABLE V.—PROPERTIES OF PULP AT 400 ML. S.R.

Bleach Demand, %	Beating Time to 400 ml. S.R.	Bursting Strength, points/ 100 lb.	Tear Factor	Apparent Density	TAPPI Opacity
0	40.0	99.0	0.815	15.5	59.0
10	37.0	97.8	0.905	17.25	60.0
15	38.0	91.5	0.905	17.30	60.0
20	38.0	86.0	0.960	17.20	60.5
25	39.0	92.0	0.825	17.25	56.0
30	40.0	103.0	0.820	17.50	52.5
40	42.0	109.0	0.690	18.0	48.0
50	43.0	108.0	0.715	17.5	49.0
60	42.0	106.0	0.710	17.5	50.5
70	39.0	107.0	0.655	17.5	48.0
80	40.0	95.5	0.650	17.5	48.5
90	40.0	92.5	0.685	17.0	51.0
110	36.0	69.0	0.560	17.55	55.0

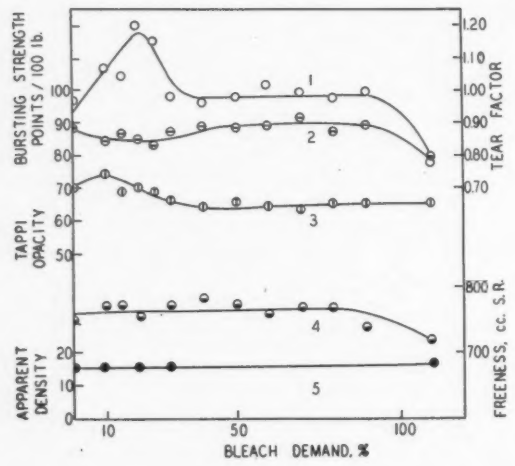

FIG. 3

Properties of Unbeaten Pulp. 1. Tear Factor; 2. Bursting Strength; 3. TAPPI Opacity; 4. Freeness; 5. Apparent Density

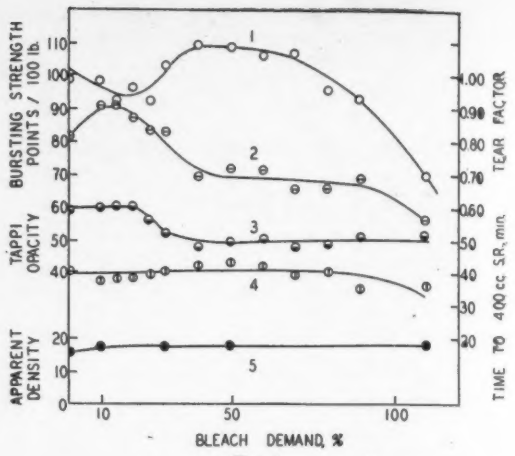

FIG. 4

Properties of Pulp at 400 cc. S.R. 1. Bursting Strength; 2. Tear Factor; 3. Opacity; 4. Time to 400 cc. S.R., min.; 5. Apparent Density

The effect of bleaching upon the beating characteristics of the pulps after treatment with various percentages of the bleach demand was studied and the properties of the beaten pulps were determined. The data for the properties at a freeness of 400 ml. S. R. are given in Table V and Figs. 3 and 4.

It is interesting to observe that, between 0 and 30% bleach demand, the tear factor shows a marked increase in value over that of the unbleached pulp, reaching a maximum at 20% demand; in one pulp a 20% increase over the unbleached pulp was obtained. This phenomenon did not vanish on beating, because the tearing strength at 400 ml. freeness showed the same increase and maximum point. Further bleaching caused the tear to decrease to a fairly constant value. Over-bleaching (110% bleach) produced sufficient degradation to effect a sharp decrease.

The bursting strength showed a decrease in the same range. On continuing the bleaching operation, the bursting strength increased to a fairly constant value, unless the pulp was degraded by overbleaching. The decrease in the bursting strength was not as pronounced as the increase in the tearing strength for unbeaten pulps when these pulps were treated with small percentages of bleaching agent. At 400 ml. freeness, the increase in tear and the decrease in bursting strength were approximately of the same magnitude.

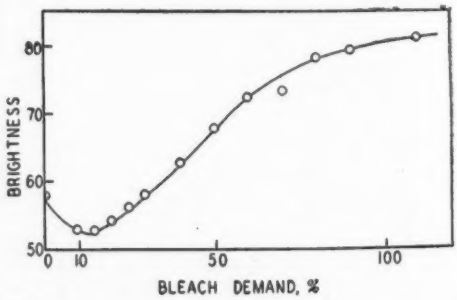

FIG. 5

Effect of Bleaching on Brightness

Effect of Optical Characteristics

Brightness

The brightness of the various samples, as determined with the General Electric reflection meter, is given in Table VI and in Fig. 5. These values pass through a definite minimum before the actual purpose of the bleach liquor—i.e., to brighten the stock—is realized. The brightness reached its lowest value with the first small addition of bleach liquor. Approximately 30% of the total bleach demand was required to bleach the pulp through this minimum region of brightness to the value shown by the unbleached sample. After the minimum brightness was attained, the brightness increased practically as a linear function of the bleach liquor concentration. At a brightness of about 75, the increase became significantly lower as the amount of bleach liquor was increased and further increases in brightness were obtained only at the expense of relatively large quantities of bleaching agent.

TABLE VI.—EFFECT OF BLEACHING ON BRIGHTNESS

Bleach Demand, %	Brightness
0	57.9
10	52.8
15	52.7
20	54.2
25	56.0
30	57.8
40	62.7
50	67.7
60	72.3
70	72.9
80	77.9
90	79.0
110	81.4

Spectrophotometer Curves

The reflectance of each pulp sample, for wavelengths from 400 to 700 mmu, was determined with the General Electric recording spectrophotometer. The immediate change in color of the pulp upon the addition of a small amount of bleaching agent is confirmed by these curves. In passing through the minimum region in brightness to a value equal to that of the unbleached pulp (mentioned in the preceding paragraph) the color of the pulp is transformed from a reddish to a yellowish cast. This marked change in color is observed on comparison of the reflectance curves for the 0 and 30% bleach samples. Although the spectrophotometer curves for these two samples pass through the same reflectance value at 457 mmu (effective wavelength for the brightness tester), the curve for the unbleached pulp is flatter, whereas that for the 30% bleach has a steeper slope.

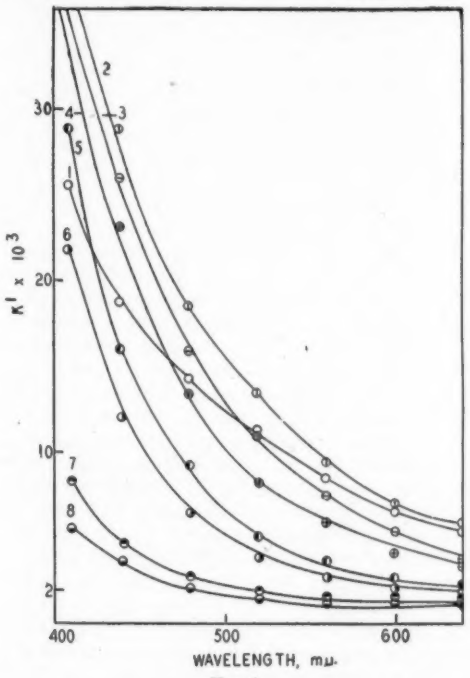

Fig. 6

Relation of Specific Absorption Coefficient to Wavelength. Curves 1-8: 0, 10, 20, 30, 40, 50, 80, and 110% Bleach Demand, respectively

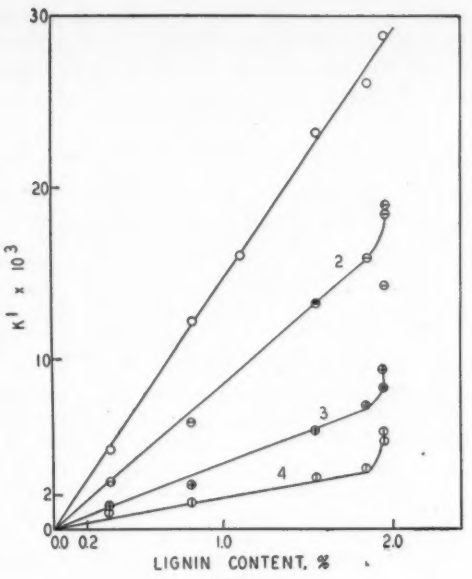

Fig. 7

Relation of the Lignin Content to the Specific Absorption Coefficient. 1. 440 mmu; 2. 480 mmu; 3. 560 mmu; 4. 640 mmu

Specific Absorption Coefficients

The specific absorption coefficient (defined expressly as the relative amount of light lost by absorption per unit areal weight of material) is dependent almost entirely upon the chemical composition of that material. It is influenced to some extent by the degree of bonding between fibers and the index of refraction. These coefficients (K′) were calculated for each pulp sample (Table VII) and a plot of these values against the wavelength is shown in Fig. 6. Bleaching seemed to follow a definite pattern in its effect on the specific absorption coefficient. Bleaching with 10% of the bleach demand caused a decrease in brightness with a corresponding increase in the specific absorption coefficient. However, this increase occurred to a greater degree in the short wavelength portion of the visible spectrum (essentially between 400 and 520 mmu). Progressive bleaching then causes a greater effect in this wavelength region. When the K′ values are plotted against the amount of bleaching agent at each wavelength, it is seen that the K′ value is the highest or reaches a maximum at the point of minimum brightness of the pulp.

The values for the alpha-cellulose content of the pulp, when plotted against the specific absorption coefficients, show that alphacellulose has no significant relation to these coefficients. A plot of the lignin content against the specific absorption coefficient (Fig. 7) shows a straight line correlation between these values for lignin contents up to about 1.85% (i. e.,

the 20% bleach sample). In other words, the color of the pulp from 0 to 20% bleach is independent of the lignin content. Above this point color bears a direct relationship to the amount of lignin remaining in the pulp. The first amount of bleaching agent consumed definitely seems to change the color of the lignin by chemical reaction and to transform it into a state which can be removed easily by the continuation of the bleaching action. After the lignin has reached this condition, its color is no longer changed by further bleaching reactions, the color change observed in a pulp beyond this point being caused entirely by a removal of the lignin.

TABLE VII.—EFFECT OF BLEACHING ON THE SPECIFIC ABSORPTION COEFFICIENT

Bleach Demand, %	Wavelength (Millimicrons)							
	410	440	480	520	560	600	640	680
0	25.7	18.8	14.28	11.20	8.415	6.47	5.175	4.33
10	41.1	28.9	18.50	13.45	9.35	6.89	5.64	4.34
15	38.9	28.4	18.70	12.85	8.90	6.45	4.69	3.61
20	37.0	26.1	15.90	10.93	7.22	5.20	3.58	3.16
25	37.6	26.5	15.51	10.09	6.66	4.65	3.43	2.66
30	37.9	23.2	13.30	8.03	5.75	4.05	3.13	2.63
40	29.0	16.0	9.27	4.88	3.53	2.54	1.95	1.75
50	22.0	12.05	6.34	3.74	2.47	1.92	1.596	1.506
60	15.24	8.82	4.55	2.75	1.935	1.565	1.42	1.348
70	15.00	8.45	4.33	2.68	1.89	1.54	1.45	1.38
80	8.35	4.66	2.64	1.68	1.345	1.17	1.12	1.091
90	7.79	4.26	2.63	1.94	1.596	1.465	1.40	1.39
110	5.65	3.54	1.98	1.461	1.24	1.14	1.112	1.11

Specific Scattering Coefficients

The scattering coefficient is dependent upon such factors as particle size and shape, degree of bonding between fibers, and the index of refraction of the fibers. The calculation of these values (Table VIII) indicated that bleaching to within 20% of the belach requirement produced pulps with higher specific scattering coefficients than those observed with unbleached pulps. Further bleaching caused the specific scattering to increase, unless the purification process had rendered the pulp so susceptible to mechanical work that any energy expended on the pulp caused a decrease in the scattering power. Bleaching was observed to produce a greater effect on the scattering coefficient at the shorter wavelengths.

TABLE VIII.—EFFECT OF BLEACHING ON SPECIFIC SCATTERING COEFFICIENT ($S' \times 10^2$)

Bleach Demand, %	Wavelength (Millimicrons)							
	410	440	480	520	560	600	640	680
0	10.34	10.62	10.70	10.45	10.35	10.17	9.94	9.76
10	11.20	11.55	11.04	11.09	10.85	10.80	10.61	10.50
15	9.94	10.81	10.84	10.76	10.70	10.70	10.47	10.30
20	9.93	10.83	10.60	10.97	10.71	10.90	10.97	10.97
25	10.61	11.75	11.65	11.60	11.35	11.15	10.82	10.65
30	11.85	11.60	11.35	11.10	11.20	10.80	10.63	10.52
40	11.28	10.65	11.17	10.88	10.60	10.38	10.27	10.20
50	11.80	11.50	11.45	11.00	10.81	10.65	10.49	10.42
60	12.20	12.20	11.66	11.40	11.11	11.00	10.90	10.80
70	12.55	12.05	11.55	11.35	11.00	10.82	10.79	10.60
80	11.28	11.10	10.92	10.59	10.48	10.11	9.95	9.73
90	12.21	11.83	11.50	11.29	11.06	10.90	10.72	10.69
110	12.16	12.00	11.38	11.21	11.07	10.80	10.56	10.53

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Relative Toxicity of Disinfectants Recommended for Use in the Paper Industry*

I. Inhibiting Concentrations for *Aerobacter Aerogenes*

By John W. Appling[1] and John F. McCoy[2]

Abstract

The Biological Control Committee of the American Paper and Pulp Association sponsors a program for the evaluation of commercial disinfectants which are recommended for microbiological control in the paper industry.. The inhibiting concentrations for each of ten disinfectants have been determined for one non-spore-forming species of bacteria (Aerobacter aerogenes), which is an important species in paper mill slime. These inhibiting concentrations, which were determined by a Petri plate technique, have been arranged in descending order to give the relative toxicity valus. Average cost data have been furnished by the manufacturers of the various materials tested for the information of the prospective consumer, who is cautioned not to draw hasty conclusions either from the cost data or from the relative toxicity data for one test organism.

Under laboratory conditions the merits of a chemical disinfectant are generally expressed in those concentrations which produce either killing or inhibition of growth. A definite concentration of a given disinfectant will kill all bacteria under test—this value is centration will completely inhibit the growth of the same bacteria—the lowest concentration which will do this is called the *inhibiting concentration*. In the case of some disinfectants and some bacteria, there may be no significant difference between the killing and the inhibiting concentrations; however, large differences usually exist between these values. In pulp and paper mill systems, it is often impractical and uneconomical to maintain killing concentrations of disinfectants; hence, there is greater interest in the knowledge and application of the inhibiting concentrations. It should be emphasized that bacteria can withstand inhibiting concentrations and, if the dosage is lowered for sufficient time, these same bacteria will soon attain normal growth and multiplication. There is great need of maintaining the required inhibiting concentration, which probably is purposely exceeded by an arbitrary safety margin in some mills in order to insure proper microbiological control.

Although there are many disinfectants on the market for use in the paper industry, there are not many data in the literature to show how these various materials compare with one another. Appling and Shema (*1*) reported laboratory data for inhibiting and killing concentrations as determined by the Petri plate and the Flask methods for a number of commercially available disinfectants, many of which are

* This paper is a special contribution to the TAPPI Number of the Paper Trade Journal.

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recommended by their respective manufacturers for called the *killing concentration*. Usually a lower conslime control in paper mills. Recently King (*2*) reported the results of laboratory and mill tests with a large number of chemical disinfectants. These results were based upon the ability of the materials tested to inhibit and to kill the micro-organisms which were present in the paper-machine white water of a particular mill. There are numerous instances of mill performance data which are very illuminating in some ways but which usually do not involve the use of more than a few chemical disinfectants. Comparative data have undoubtedly been obtained by the various manufacturers of disinfectants but these are not generally available except for emphasizing the merits of a particular product.

Test Technique

After considerable experience with the Petri plate method for determining inhibiting concentrations of disinfectants and with the Flask method (*1*) for determining the killing concentrations of the same, the authors decided upon the extensive use of the former, using each of several test organisms. The Petri plate method has given more consistent and reproducible results than the Flask method, both in the laboratory of The Institute of Paper Chemistry and in the laboratory of a manufacturer of chemical disinfectants which worked cooperatively with the Institute. In addition, the plate method is less time consuming and requires less material and equipment than does the Flask method. It should be remembered that, although the plate method is invaluable for obtaining inhibiting concentrations, it is probably of doubtful value for obtaining killing concentrations.

Test Organisms

The results which are being reported at this time are based on laboratory work at The Institute of Paper Chemistry under the sponsorship of the Biological Control Committee of the American Paper and Pulp Association. The inhibiting concentrations of ten commercial disinfectants have been determined for the test organism *Aerobacter aerogenes*. This nonspore-forming species of bacteria was selected because of the frequency with which it has been isolated from paper mill slimes. The culture used was originally obtained from the University of California and is now maintained in the culture collection of the Institute.

Petri Plate Method

The Petri plate method as used will be described at this point. The desired concentrations of the disinfectant to be tested are incorporated into hot sterile Bacto Nutrient Agar. The latter is prepared in the usual manner, melted and cooled to about 55°C., which is warm enough to insure thorough mixing with the solution of the disinfectant. The melted sterile agar is kept in a 55°C. oven until it is needed for mixing with the disinfectant. The latter is dissolved in an amount of distilled water to give the stock solution required for the range of concentrations to be tested. As an example, the following table will show the amount of agar and stock solution of disinfectant required for several agar mixtures containing the disinfectant:

TABLE I.—AGAR-DISINFECTANT MIXTURES

Concentration of Disinfectant in Agar, % by weight	Volume of Melted Sterile Agar per Plate, ml.	Volume of Stock Solution Containing 0.25% by Weight of Disinfectant, ml.
0.0000 (control)	10.0	0.0
0.0025	9.9	0.1
0.0050	9.8	0.2
0.0075	9.7	0.3
0.0100	9.6	0.4
0.0125	9.5	0.5

The stock solution of the disinfectant is first pipetted into the sterile Petri dishes and then the hot sterile nutrient agar is pipetted into them. Each plate is rotated immediately after adding the agar to insure thorough mixing of the disinfectant with the melted agar. The plates are allowed to stand at room temperature for approximately 2 hours. Meanwhile, a water suspension of the test organism *(Aerobacter aerogenes)* is prepared from a 24-hour bottle slant of the organism grown at 37°C. (the bottle slant is made by slanting approximately 20 ml. of nutrient agar in an 8-ounce narrow-mouthed square-sectioned glass dilution bottle). The entire growth is aseptically washed from the slant into a dilution bottle containing 100 ml. of sterile water.

Each poured plate is divided into two parts to be streaked separately with a loopful of the prepared suspension of the test organism. The size of the loop is 3 mm. After streaking the plates, they are incubated at 37°C. for 24 hours or longer if necessary to obtain good growth in the lower concentrations of the disinfectant. Each run reported in the present paper consisted of two streakings, sometimes on the same plate and sometimes on duplicate plates.

Agents Tested

Ten chemical disinfectants have been tested in the above manner and the results have been summarized in Table II. The trade names of the materials rather than the chemical composition of the disinfectant have been used. In most cases, however, the respective manufacturers have no odjection to giving the chemical composition to anyone interested. The materials have been tested as furnished by the manufacturer and the inhibiting concentrations have been reported on this basis. Thus, the manufacturers of Lignasan give the analysis of this disinfectant in terms of the active ingredient, ethyl mercury phosphate. The results reported in Tables II and III are based on the product as sold, not on the concentration of ethyl mercury phosphate. More than two test runs were made in many cases; however, only the data from the last two test runs made are given in Table II.

Comparison of Disinfectants

In order to compare the disinfectants tested for their ability to inhibit the growth of *Aerobacter aerogenes* under otherwise optimum conditions of growth, the average values for the inhibiting concentrations were calculated from Table II and are arranged in decreasing order to toxicity in Table III. This table shows that Merfenel was the most toxic of the ten tested and, for this reason, the value of one was assigned to it as its relative toxicity. Since the other nine materials were less toxic in proportion to the increasing values of the inhibiting concentrations, the relative toxicity values really represent the ratios between these inhibiting concentrations. An example should make this point clearer. Penetox inhibited the test organism as a concentration of 0.0500% and Lignasan did so at a concentration of 0.0010%. The ratio of these concentrations is 50:1, which is the ratio of the relative toxicity values in the last column. It may be expected that approximately fifty times as much Penetox as Lignasan will be required to inhibit the growth of micro-organisms having the same de-

gree of resistance as the test organism.

It is planned to determine the inhibiting concentrations for other test organisms—namely, a spore-forming species of bacteria and a commonly occurring species of mold. The data will appear in subsequent papers in this series. Undoubtedly the inhibiting concentrations and the relative toxicity values will differ from one test organism to another and the data will have to be applied carefully to each problem of microbiological control.

TABLE II.—INHIBITING CONCENTRATIONS OF VARIOUS DISINFECTANTS FOR *AEROBACTER AEROGENES* AS DETERMINED BY THE PETRI PLATE METHOD

Trade Name of Disinfectant	Range of Concentration Tested, %	Increment Used in Range, %	Inhibiting Concentration	
			Streak 1	Streak 2
1. Lignasan	0.0002-0.0020	0.0002	0.0010	0.0012
	0.0002-0.0020	0.0002	0.0008	0.0010
2. Merfenel	0.00001-0.0005	0.00005	0.0001	0.0002
	0.00005-0.0002	0.00005	0.0001	0.0001
3. Nalco 21	0.0600-0.0900	0.0050	0.0750	0.0750
	0.0600-0.0900	0.0050	0.0750	0.0750
4. Nalco 21-B	0.0025-0.0200	0.0025	0.0075	0.0075
	0.0025-0.0150	0.0025	0.0100	0.0100
5. Nalco 21-M	0.0050-0.0500	0.0050	0.0250	0.0350
	0.0050-0.0500	0.0050	0.0450	0.0500
6. Nalco 23	0.0300-0.0800	0.0050	0.0450	0.0500
	0.0300-0.0800	0.0050	0.0400	0.0450
7. Penetox	0.0250-0.0500	0.0050	0.0450	0.0500
	0.0350-0.0500	0.0050	0.0500	0.0500
8. Permatox 1-S	0.0015-0.0040	0.0005	0.0030	0.0040
	0.0020-0.0045	0.0005	0.0035	0.0040
9. P. M. 32 Powder	0.0010-0.0020	0.0002	0.0014	0.0014
	0.0010-0.0020	0.0002	0.0014	0.0016
10. Santobrite	0.0050-0.0300	0.0050	0.0250	0.0200
	0.0050-0.0250	0.0025	0.0225	0.0225

TABLE III.—RELATIVE TOXICITY IN TERMS OF THE MOST TOXIC MATERIAL TESTED

Trade Name of Disinfectant	Inhibiting Concentration, % by Weight (Average)*	Relative Toxicity
1. Merfenel	0.0001	1
2. Lignasan	0.0010	10
3. P. M. 32 Powder	0.0014	14
4. Permatox 1-S	0.0035	35
5. Nalco 21-B	0.0100	100
6. Santobrite	0.0225	225
7. Nalco 21-M	0.0400	400
8. Nalco 23	0.0450	450
9. Penetox	0.0500	500
10. Nalco 21	0.0750	750

* Average made on basis of increments used in each case.

Cost of Control

Irrespective of the toxicity data for a given disinfectant, consideration must be given to the cost of the material. Technical mill men and mill executives may even limit their consideration of a given product to its cost in relation to the cost of one for which it is proposed to be substituted. Cases are known where a new product has been tried in a mill, not on the basis of the concentrations recommended by the manufacturer of the disinfectant, but on the basis of the dosage which can be applied at the same cost as the disinfectant being used. It is recognized that cost data are one important consideration in the choice of a disinfectant for a paper or pulp mill, but the latter should not be guided solely by cost data. The authors have requested from the manufacturers of the ten disinfectants listed in Tables II and III average cost data for their products. The co-operation has been excellent and Table IV summarizes these data.

The user of disinfectants must be extremely careful in attempting to interpret the data in this and subsequent papers. The control of slime may be cited as an example of microbiological control which is common to many pulp and paper mills. Much has been published on the nature and control of slime. The microbiologists, as well as the technical mill men, can recognize many different types of slime; consequently, the control of slime should not be calculated solely on the basis of one set of toxicity data and certainly not on the basis of cost alone. It is the hope of the Biological Control Committee of the American Paper and Pulp Association that the data in this and subsequent papers will contribute materially to the intelligent application of disinfectants to microbiological control in the paper industry.

Extent of Program

The Committee is anxious to expand the present testing program to include all commercially available disinfectants which are being recommended for use in the paper industry. It is willing to test representative samples which any mill may wish to have examined. The manufacturers of the disinfectants will, of course, continue to carry out their own testing programs but, from time to time, new products which they found promising should be evaluated by other testing laboratories. The Committee will be glad to include such promising new materials when its testing program will so permit.

Literature Cited

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2. King, G., *Pacific Pulp Paper Ind.* 18, No. 6: 39-42, 44, 46 (June, 1944).

Paper Sales Show Increases

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., September 11, 1944—Wholesalers' sales of paper and paper products totaled $54,071,000 for the first 7 months of 1944, a gain of 7 percent over the corresponding period of last year, the Bureau of Census reported for a group of 79 firms, based on their sales figures.

Sales for the same group, in July, amounted to $5,554,000, a decline of 14 percent from June, and 7 percent under those reported for the same month of 1943.

Inventories, based on figures of 36 firms, amounted to $3,327,000 in July, only negligibly different from June inventories, but 8 percent under those of July last year.

TABLE IV.—COST DATA FOR VARIOUS DISINFECTANTS

Trade Name of Disinfectant	Name and Address of Manufacturer or Distributor	Average Price Quoted *
1. Lignasan	E. I. du Pont de Nemours & Co., Wilmington, Del.....	$0.48 per pound in lots of 1,000 pounds.
2. Merfenel	Hamilton Laboratories, Inc., Asheville, N. C.....	$0.70 per ounce in lots of 4,000 or more.
3. Nalco 21	National Aluminate Corp., 6216 W. 66th Pl., Chicago 38, Ill.....	$0.13 per pound.
4. Nalco 21-B	National Aluminate Corp., 6216 W. 66th Pl., Chicago 38, Ill.....	$0.165 per pound.
5. Nalco 21-M	National Aluminate Corp., 6216 W. 66th Pl., Chicago 38, Ill.....	$0.19 per pound.
6. Nalco 23	National Aluminate Corp., 6216 W. 66th Pl., Chicago 38, Ill.....	$0.165 per pound.
7. Penetox	Magnus Chemical Co., Garwood, New York.....	$0.20 per pound in 500-pound containers.
8. Permatox 1-S	Central Laboratories, Inc., Memphis, Tenn.....	$0.50 per pound for 20 or more 50-lb. cartons.
9. P. M. 32 Powder	Falls Chemical Products Co., Oconto Falls, Wis.....	$0.80-$0.98 per pound depending upon consumption.
10. Santobrite	Monsanto Chemical Co., St. Louis, Mo.....	$0.15 per pound.

* It must be understood that the cost data are only representative and in nearly every case the cost will depend upon the consumption of the disinfectant. In all cases the paper or pulp mill should consult directly with the manufacturer.

A Note on the Effect of Repeated Treatment of Corncob Lignin by the 72% Sulphuric Acid Method

By E. C. Dryden[1], J. D. Reid[2] and S. I. Aronovsky[3]

Abstract

The effect of cold 72% sulphuric acid on alkali lignin has been studied. It was found that there is a partial degredation and solution of the lignin, the loss being slightly less than when the lignin is treated with hydrochloric acid. There is also a decrease in the number of methoxyl groups.

During the course of investigations, carried on at the Agricultural Byproducts Laboratory, Ames, Iowa, on the effects of monoethanolamine upon lignin *(3)*, it was found that corncob alkali lignin, upon treatment with cold 72% sulphuric acid and boiling with dilute acid, underwent an appreciable loss of weight when again subjected to the same treatment. Hägglund and Björkman have shown that alternate treatment of spruce lignin with cold fuming hydrochloric acid and with boiling dilute acid caused a continual decrease in the yield, until eventually less than half of the original material remained *(1)*. Phillips has also demonstrated that Willstätter lignin from wheat straw undergoes hydrolysis when treated in a similar manner *(2)*. A relatively large loss of lignin occurs in the first treatment (12.5% of the Willstätter lignin), this loss decreasing with each successive treatment. The methoxyl contents of the residues remained practically constant, indicating that the lignin was being dissolved *in toto* without preferential hydrolysis of any constituent groups *(2)*.

On the basis of these findings, it seemed desirable to determine the effect on lignin of repeated treatment with strong and dilute sulphuric acid. The material used was corncob lignin, obtained by precipitation from alkaline solution with dilute sulphuric acid *(3)*. In this study two ratios of 72% sulphuric acid to lignin were employed, viz., 15 ml. per gram, which is the ratio used in the quantitative lignin determination *(4)*, and 2.5 ml. per gram, which was the ratio used in purifying the original alkali lignin for use in the above-mentioned work *(3)*. The lignin and acid were allowed to react for 2 hours at 20°C. with frequent stirring. After the 2-hour period, the mixture was

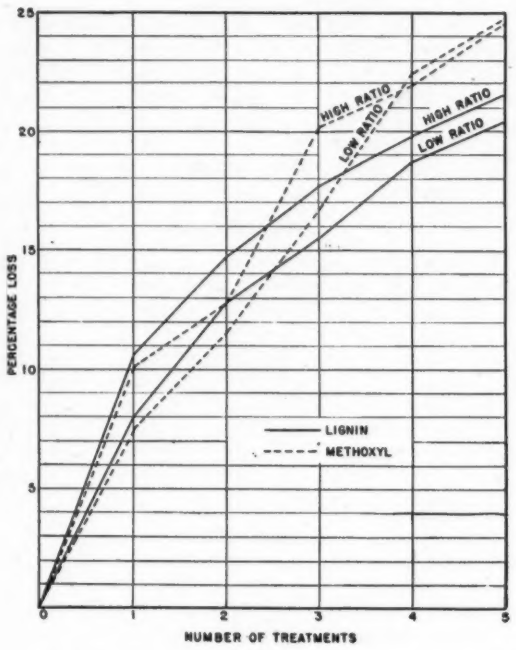

FIG. 1

Percentage Loss of Lignin and Methoxyl (Based on the Amounts Originally Present) upon Repeated Treatment by the 72% Sulphuric Acid Method

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[3]Member TAPPI; Head, Pulp and Paper Section, Agricultural Residues Division, Northern Regional Research Laboratory, Peoria, Ill. This is one of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.
[4]Established by the Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture, in cooperation with Iowa State College. The Agricultural By-products Laboratory was transferred to the Northern Regional Research Laboratory, Peoria, Illinois, on July 1, 1941, and its work is being continued by the Agricultural Residues Division.

TABLE I.—EFFECT OF REPEATED TREATMENT OF ALKALI CORNCOB LIGNIN BY THE 72% SULPHURIC ACID METHOD.

	High Acid Ratio 15 ml. H_2SO_4 solution per gram lignin				Low Acid Ratio 2.5 ml. H_2SO_4 solution per gram lignin			
	Yield of Residue %	Total yield (Base on original lignin) %	Methoxyl in Lignin %	Total Metroxyl (Based on original lignin) %	Yield of Residue %	Total Yield (Based on original lignin %	Methoxyl in Lignin %	Total Methoxyl (Based on original lignin) %
Alkali lignin	100.00	100.00	13.46	13.46	100.00	100.00	13.46	13.46
1st treatment	89.52	89.52	13.52	12.10	92.04	92.04	13.52	12.44
2nd treatment	95.30	85.31	13.74	11.72	94.62	87.09	13.67	11.91
3rd treatment	96.44	82.28	13.06	10.75	96.96	84.44	13.26	11.20
4th treatment	97.48	80.20	13.10	10.51	96.32	81.33	12.84	10.44
5th treatment	98.04	78.63	12.90	10.14	97.82	79.56	12.72	10.12

diluted with water to 3% acid content, boiled for 2 hours, filtered through a fritted glass crucible (IG3), washed thoroughly with hot water, dried, and weighed. After removing samples for methoxyl determination, the dried material was again treated with 72% sulphuric acid. This procedure was carried out five times. The results, shown in Table I and Fig. 1, are the mean of two or more individual determinations.

It may be seen from the data that each treatment resulted in a loss of lignin. However, the percentage loss of lignin decreased, in general, with each successive treatment. The lignin losses were somewhat greater in the case of the higher acid-lignin ratio, especially in the early treatments.

The methoxyl contents of the residues showed little change during the first two treatments, but dropped slightly with succeeding treatments, indicating probable degradation of the lignin. The total methoxyl content, based on the original lignin, decreased steadily throughout these experiments. The ratio of acid to lignin apparently had a variable influence on the loss of methoxyl groups, as shown in Fig. 1.

Conclusions

Repeated treatment of alkali lignin with cold 72% sulphuric acid and hot dilute 3% sulphuric acid results in partial degradation and solution of the lignin at a gradually decreasing rate as the number of treatments increases. The loss of lignin is somewhat smaller than that reported for the experiments with hydrochloric acid. The methoxyl groups decrease at about the same rate as the lignin itself, during the first two treatments. With succeeding treatments, however, the percentage loss of methoxyl is greater than that of the lignin.

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4. Ritter, G. H., Seborg, R. M., and Mitchell, R. L. *Ind. Eng. Chem.*, Anal. Ed. *4*, 202 (1938).

TAPPI Notes

Frank P. Silver, formerly of the Bowater's Newfoundland Pulp and Paper Mills, Ltd., is now assistant general superintendent at the Riverbend, P. Q. mill of Price Bros. & Co., Ltd.

Fred L. Jacoby is now general superintendent of the Riegel Paper Corporation, Milford, N. J.

A Wood Utilization Conference will be held at the New York State College of Forestry, Syracuse, N. Y., on October 6-7, 1944. The College paper machine will operate and make the newly developed Willard Fibrite battery separator sheet. There will be many exhibits in both the paper and plastics field. E. C. Jahn will talk on Wartime Wood Products in Sweden; J. F. T. Berliner of Du Pont on Methylolurea Treated Wood; F. A. Hartman of Protexol Co. on Fire-Resistant Treatment of Wood; Floyd C. Peterson of Dow Chemical Co. on Developments in Cellulose and Lignin Plastics; Lyman Beeman of St. Regis Paper Co. on New Developments in Pulp and Paper Products. There will be several other papers dealing with the wood industries.

The executive committee of the TAPPI Delaware Valley Section met at the Engineers Club, Philadelphia, on October 8. The Rev. J. J. Molloy of St. Josephs College, Philadelphia, Pa., announced that a 16 weeks' course in pulp and papermaking would be given at the college on Thursday evenings, beginning October 12. This is a tuition free course open to all interested in the subject. Lectures will be given this year by Messrs. Brainerd and Fronmuller of the Scott Paper Company. Lois Hans, secretary of the Section, reported a membership of 156. L. K. Burnett, of the Curtis Publishing Company, reported plans for promoting membership and attendance at meetings. C. M. Conner, chairman of the program committee, announced that the first meeting would be held at the Engineers Club on October 6, 1944. John Cornell will talk on "Reconversion and Postwar Realities." Tentative plans have been made for several meetings to be scheduled during the year on the first Friday evening of each month. Those present included Ken Britt and F. W. Brainerd, Scott Paper Company; A. W. Bixler, Riegel Paper Corporation; J. C. Dieffenderfer and Lois Hans, Hercules Powder Company; Louise McGrath, Booth Chemical Company; C. M. Conner, Valley Forge Laboratories; W. M. Shoemaker, Douglas T. Sterling Company; J. Carl Schmidt, duPont; T. W. Toovey, Pennsylvania Salt Manufacturing Company; Jacob Edge, Downingtown Manufacturing Company; E. J. Albert and E. R. Baublitz, Thwing-Albert Instrument Company; Harry Hulmes, U. S. Rubber Company; L. K. Burnett, Curtis Publishing Company; Rev. J. J. Molloy, St. Josephs College, and R. G. Macdonald, secretary of TAPPI.

Chemical Engineering Thermodynamics

The McGraw-Hill Book Company has recently published a book entitled Chemical Engineering Thermodynamics (675 pages) by Barnett F. Dodge, Professor of Chemical Engineering, Yale University. Although written primarily for graduate students, this book assumes no previous knowledge of thermodynamics and develops each topic from fundamentals that are known to those who have a working knowledge of physics, physical chemistry and elementary calculus. Chapters cover the first two fundamental laws of thermodynamics and in general deal with their application to heat transfer, refrigeration, chemical reaction equilibrium, vaporization and condensation equilibria, properties of fluids, etc. The large influx of chemical engineers into the pulp and paper industry in the past few years has been leading to a better engineering approach to mill problems based on engineering fundamentals as covered in books of this kind. Copies may be obtained from the Book Department of the Thechnical Association of the Pulp and Paper Industry, 122 E. 42nd street, New York 17, N. Y., at $6.00 per copy.

Arthur D. Little, Inc., Adds to Staff

H. W. Christoffers, L. T. Dupree and R. B. Schneider have recently joined the staff of Arthur D. Little, Inc., Cambridge, Mass., industrial research organization. The addition of these men to the Arthur D. Little, Inc., staff indicates the firm's increased activities in the field of technical-economic evaluations and investigations. Mr. Christoffers was previously with Commercial Filters Corporation, Mr. Dupree with Servel, Inc. and Mr. Schneider with the central development group of Allied Chemical and Dye Corporation.

PRINTING COMMITTEE OPENS BIDS FOR PAPER

(Continued from page 70)

No. 56—4,000,000 lbs., white No. 36; flat, cut any size, min. width 21 ins., max. width 48 ins.

Whitaker Paper Co. .....
(800,000 lbs. on one or all lots) 7.44c
R. P. Andrews Paper Co. .....
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Barton, Duer & Koch Paper Co..
(250 tons on all items) 7.25c

No. 57—1,000,000 lbs., white, No. 32; rolls, min. width 16 ins., max. width 48 ins. (3-inch fiber cores).

Whitaker Paper Co. .....
(800,000 lbs. one or all lots) 7.21c
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Barton, Duer & Koch Paper Co...
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Central Ohio Paper Co. .....
(100,000 lbs. only) 6.79c
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(400,000 lbs. only) 7.11c
Marquette Paper Co. 7.6145c
Stanford Paper Co. .....
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No. 58—2,000,000 lbs., white, No. 36; rolls, min. width 16 ins., max. width 48 ins. (3-inch fiber cores).

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(360,000 lbs., 120,000 lbs. per month) 6.59c

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Chemical Wood Manifold, White and Colored

No. 71—500,000 lbs., white, No. 18; flat, cut 21x32, and 32x42 ins.; the grain to run 21-inch and 42-inch ways.

North American Pulp & Paper Co.
(200,000 lbs. only) 10.25c
Graham Paper Co. .....
(200,000 lbs. total lots 71 and 73) 9.90c
Old Dominion Paper Co. .....
(100,000 lbs. only) 10.997c

No. 73—100,000 lbs., blue, green, pink, and yellow, No. 18; flat, cut 21x32, 22x34, 28x34, 32x42, and 34x44 ins.; the grain to run the 21-inch and 42-inch ways. Min. order, one color 5,000 lbs.

North American Pulp & Paper Co.
(50,000 lbs. only) 11.25c
Graham Paper Co. .....
(200,000 lbs. total lots 71 and 73) 11.00c

50 Per Cent Manifold, White and Colored

No. 76—100,000 lbs., white, No. 18; flat, cut 21x32, 22x34, 28x34, 32x42, and 34x44 ins.; the grain to run the 21-inch and 42-inch ways.

Paper Corp. of U. S. 20.50c
Barton, Duer & Koch Paper Co... 18.90c
Old Dominion Paper Co. .....
(50,000 lbs. only) 17.987c

No. 78—80,000 lbs., blue, cherry, green, pink, salmon and yellow, No. 18; flat cut 21x32, 22x34, 28x34, and 34x44 ins.; the grain to run the 21-inch way on the 21x32-inch size. Min. order, one color, 5,000 lbs.

Barton, Duer & Koch Paper Co... 18.90c
Old Dominion Paper Co. .....
(50,000 lbs. only) 18.236c

Chemical Wood Bond, White and Colored

No. 101—80,000 lbs., white, No. 26; flat, cut any size, min. width 21 ins.; max. width 38 ins.

Eastern Corp. 11.46c

No. 102—150,000 lbs., white, No. 32; flat, cut any size, min. width 21 ins.; max. width 38 ins.

Eastern Corp. 9.31c

No. 103—80,000 lbs., blue, No. 32; flat, cut 32x42 ins.

Eastern Corp. 10.04c

No. 104—40,000 lbs., blue, buff, green, pink, salmon, and yellow No. 26; flat cut any size min. width 21 ins., max. width 38 ins. Min. order, one color, 5,000 lbs.

No bids

25 Per Cent Bond, White and Colored

No. 105—200,000 lbs., white, No. 26; flat, cut any size, min. width 21 ins.; max. width 48 ins.

Aetna Paper Co. 16.46c

No. 106—700,000 lbs., white, No. 32; flat, cut any size, min. width 21 ins., max. width 48 ins.

Aetna Paper Co. .....
(total 1,200,00 lbs. on 106, 107 and 108) 14.36c

No. 107—700,000 lbs., white, No. 32; flat, cut any size, min. width 21 ins., max. width 48 ins.

Aetna Paper Co. .....
(total 1,200,000 lbs. on 106, 107 and 108) 14.36c

No. 108—700,000 lbs., white, No. 32; flat, cut any size, min. width 21 ins., max. width 48 ins.

Aetna Paper Co. .....
(total 1,200,000 lbs. on 106, 107 and 108) 14.36c

No. 110—120,000 lbs., blue, buff, cherry, green, pink, salmon and yellow No. 32; flat, cut any size, min. width 21 ins., max. width 48 ins.

Aetna Paper Co. 14.86c

100% White Bond

No. 128—40,000 lbs., Nos. 32 and 40, flat, cut any size, min. width 16 ins., max. width 32 ins. Min. order, one substance, 2,000 lbs.

Paper Corp. of U. S. 24.25c
R. P. Andrews Paper Co. 24.25c
Barton, Duer & Koch Paper Co... 24.00c
Butler Co. 24.18c

Chemical Wood White Ledger

No. 151—200,000 lbs., No. 48, flat, cut any size, min. width 17 ins., max. width 48 ins.

Wilcox, Walker Furlong Co. .. 8.26c
Eastern Corp. 9.60c

No. 152—80,000 lbs., No. 56; flat, cut any size, min. width 17 ins., max. width 48 ins.

Wilcox, Walker Furlong Co. 8.26c
North American Pulp & Paper Co. 9.90c
Eastern Corp. 9.60c

25 Per Cent Ledger, White and Colored

No. 154—100,000 lbs., white, No. 48; flat, cut 22x34, 24x38, 28x34, 32x42, 34x44 and 38x48 ins. Min. order, one substance, 5,000 lbs.

Aetna Paper Co. 14.36c

No. 155—100,000 lbs., white, No. 56; flat, cut 22x34, 24x38, 28x34, 32x42, 34x44 and 38x48 ins. Min. order, 5,000 lbs.

Aetna Paper Co. 14.36c

No. 156—100,000 lbs., blue, buff, cherry, green, pink, salmon and yellow, No. 56; flat, cut 24x38, 38x34 and 34x44 ins. Min. order, one substance, one color, 5,000 lbs.

Aetna Paper Co. 14.86c

100% White Ledger

No. 177—40,000 lbs. No. 64; flat, cut 24x38, 28x34, 32x42 and 38x48 ins. Min. order, 5,000 lbs.

Paper Corp. of U. S. 24.25c
R. P. Andrews Paper Co. 26.25c
Barton, Duer & Koch Paper Co... 24.00c
Butler Co. 27.48c

Chemical Wood White and Colored Index

No. 183—120,000 lbs., white, 22½x28½—148; flat, cut any size, min. width 17 ins., max. width 42 ins., with projecting colored-paper marker between each 100 sheets.

Wilcox, Walker Furlong Co. 7.74c
North American Pulp & Paper Co. 8.50c

No. 184—200,000 lbs., white, 22½x28½—182 and 230; flat, cut 34½x44 ins., with projecting colored-paper marker between each 100 sheets. Min. order, one weight, 10,000 lbs.

Whitaker Paper Co. .....
(66,000 lbs. during any calendar month) 7.67c
Wilcox, Walker Furlong Co. 7.74c

50 Per Cent Index, White and Colored

No. 189—100,000 lbs., white, 22½x28½—148; flat, cut 24x38, 28x34, 34½x44 and 38x48 ins., with projecting colored-paper marker between each 100 sheets. Min. order, 10,000 lbs.

Whitaker Paper Co. 16.48c
Barton, Duer & Koch Paper Co... 13.22c

No. 190—500,000 lbs., white, 22½x28½—182 and 230; flat, cut 24x38, 28x34, 32½x42, and 34½x44 ins., with projecting colored-paper marker between each 100 sheets. Min. order, one weight, 10,000 lbs.

Whitaker Paper Co. .....
(200,000 lbs. only) 16.48c
Walker, Goulard & Plehn Co. ..
(10,000 lb. lots) 15.90c
(20,000 lb. lots) 16.65c
(30,000 lb. lots 15.50c
(50,000 lb. lots) 15.40c
(100,000 lb. lots) 15.30c
Barton, Duer & Koch Paper Co... 14.22c

No. 191—80,000 lbs., blue, buff, cherry, fawn, green, pink salmon and yellow 22½x28½—182 and 230; flat, cut 24x38, 28x34, and 34½x44 ins., with projecting colored-paper marker between each 100 sheets. Min. order, one color, one weight 5,000 lbs.

Barton, Duer & Koch Paper Co... 14.97c

No. 192—80,000 lbs., blue, buff, cherry fawn, green, pink salmon and yellow 22½x28½—148; flat, cut 24x38, 28x34, and 34½x44 ins., with projecting colored-paper marker between each 100 sheets. Min. order, one color, 5,000 lbs.

Barton, Duer & Koch Paper Co... 14.32c

100 Per Cent White Index

No. 196—50,000 lbs., 22½x28½—approximately 206; flat, cut 20½x30½ and 34½x44 ins.

R. P. Andrews Paper Co. 26.15c
Barton, Duer & Koch Paper Co... 23.00c

Antique-Finish Cover, White and Colored

No. 203—150,000 lbs., antique; white, blue, buff, dawn, quaker drab, terra cotta, gray, brown, green, gobelin blue, granite, tea and yellow; flat, 19½x25¼—95, wtih projecting colored-paper marker between each 500 sheets. Min. order, one color, 5,000 lbs.

Whitaker Paper Co. .....
(all colors except white and yellow) 8.52c
R. P. Andrews Paper Co. 8.57c

50 Per Cent Laid Cover, Colored

No. 205—100,000 lbs., blue, cream, white, gray and green, 20x26—130; flat, cut 19½x25¼ and 28x41 ins., with projecting colored-paper marker between each 500 sheets. Min. order, one color, 2,000 lbs.

R. P. Andrews Paper Co. 12.73c

Wood Manila

No. 208—100,000 lbs., 24x36—80 and 100; flat, cut 25x38 and 32x42 ins., with projecting colored paper marker between each 500 sheets.

Frank Parsons Paper Co. 5.75c

No. 210—40,000 lbs., 24x36—120; rolls, 18-ins. diameter, 4¾, 5¾, and 7½ ins. wide, wound on wooden plugs, 1½-in. hole.

Whitaker Paper Co. .....
(4¾ inch. rolls) 5.875c
(5¾ and 7½ inch rolls) 5.625c

Chemical Wood Manila

No. 211—100,000 lbs., 24x36—140 and 160; flat, cut any size. Min. order, one weight, 5,000 lbs.

Paper Corp. of U. S. 9.50c
Perkins, Goodwin Co. 10.50c

No. 2 Kraft

No. 219—150,000 lbs., 24x36—80 to 160; rolls, min. width 9 ins., max. width .48 ins., wound on wooden plugs, 1½-ins. hole, or 3-inch fiber cores as may be specified.

No bids

High-Finish Chemical Wood Manila Tag

No. 271—100,000 lbs., 24x36—280; flat, cut any size, min. width 24 ins., max. width 38 ins.

Paper Corp. of U. S. 8.98c
R. P. Andrews Paper Co. 9.00c
Perkins, Goodwin Co. 9.25c

Calendered Tag, Manila and Colored

No. 276—400,000 lbs., manila, 22½x28½—150; rolls, 23¼ and 26½ ins. wide (6-inch fiber cores with metal tips).

Barton, Duer & Koch Paper Co... 8.50c

No. 277—60,000 lbs., blue, brown, green, ivory, pink, red, salmon and yellow 22½x28½—150; rolls 23¼ and 26½ ins. wide (6-inch fiber cores with metal tips). Min. order one color, 10,000 lbs.

Barton, Duer & Koch Paper Co... 9.50c

Jute Tag

No. 280—100,000 lbs., 22½x28½—200 and 280; flat, cut 28x38 ins. Min. order, one weight, 10,000 lbs.

Mudge Paper Co. 10.50c
Perkins, Goodwin Co. 12.0c

Manila Board

No. 281—40,000 lbs., 22½x28½—400; flat, cut 22x34 ins., with projecting colored-paper marker between each 100 sheets. Min. order 10,000 lbs.

Paper Corp. of U. S. 6.42c

Railroad Board, White and Colored

No. 305—30,000 sheets, ash gray, green, orange and red, flat, 22x34 ins., 4-ply each 100 sheets fully banded. Min. order, one color, 5,000 sheets.

Barton, Duer & Koch Paper Co...
per M sheets $44.99
Stanford Paper Co. 45.31c
Old Dominion Paper Co. 45.448c

Wood Bristol, Colored

No. 307—40,000 lbs., 22½x28½—150; flat, cut 32x42 ins.

Barton, Duer & Koch Paper Co... 6.79c
Frank Parsons Paper Co. 5.85c

United States Postal Card Bristol

No. 325—1,200,000 lbs., 22½x28½—188; rolls, 22 ins. wide, 30 ins. in diameter and 33 ins. wide, 36 ins. in diameter (6-inch iron cores).

Whitaker Paper Co. .....
(1,800,00 lbs on any one or more lots) 6.22c
R. P. Andrews Paper Co. .....
(1,500,000 lbs. on any one or all lots) 6.17c

No. 326—1,200,000 lbs., 22½x28½—188; rolls, 22 ins. wide, 30 ins. in diameter and 33 ins. wide 36 ins. in diameter (6-inch iron cores).

Whitaker Paper Co. .....
(1,800,000 lbs. on any one or all lots) 6.22c
R. P. Andrews Paper Co. .....
(1,500,000 lbs. on any one or all lots) 6.17c

No. 327—1,200,000 lbs., 22½x28½—188; rolls, 22 ins. wide, 30 ins. in diameter, 33 ins. wide and 36 ins. in diameter (6-inch iron cores).

Whitaker Paper Co. .....
(1,800,000 lbs. on any one or more lots) 6.22c
R. P. Andrews Paper Co. .....
(1,500,000 lbs. on any one or all lots) 6.17c

Pressboard, Colored

No. 352—50,000 sheets, gray, flat, 30x36 ins., thickness .0300 inch. Min. order, 5,000 sheets.

Whitaker Paper Co. .....
per C sheets (25,000 lbs. Nov.) (25,000 lbs. Dec.) 22.70c
R. P. Andrews Paper Co. 23.58c
Resolute Paper Products Co. ....
(half in Nov.; bal. in Dec.) 23.93c
Barton, Duer & Koch Paper Co... 18.85c
Old Dominion Paper Co. 23.88c
Mathers, Lamm Paper Co. 24.20c

News Board

No. 360—500,000 lbs., 26x38 ins., No. 100, flat, cut any size, min. 21x32 ins., max. 40x52½ ins. (to be trimmed square on four sides).

No bids

Binder's Board, No. 1 Quality

No. 366—250,000 lbs., flat, to trim 25x30 ins., Nos. 16, 18, 20, 25, 30 and 40.

Mathers, Lamm Paper Co. 415c

No. 367—40,000 lbs., 25¾x30¾, Nos. 12 and 20; flat, to trim 34x44 ins.

No bids

Binder's Board Best Quality

No. 368—20,000 lbs., flat, to trim 20x30 ins., and 22x28 ins., Nos. 18, 20, 25, 30, 35, 40 and 45. Min. order, 5,000 lbs.

Consolidated Paper Co. 5.87c

Chestnut Cover Board

No. 369—40,000 lbs., flat, to trim 25x30 ins. Nos. 17, 19, 21, 25, 31 and 41.

No bids

Huyck Employees Reach Agreement

[FROM OUR REGULAR CORRESPONDENT]

RENSSELAER, N. Y., September 11, 1944—The mills of F. C. Huyck & Sons have reached an agreement with employees whereby the latter will receive an additional week's pay instead of another week's vacation. The employees recently had a week's vacation but under the new contract they would be given two weeks of leave from their duties. However, it is pointed out because of the demand for their services it has been found practical to give the additional compensation. Starting next year the workers will have two instead of one week's vacation.

Radiation Type Pyrometers

A new Bulletin, No. P1202, with twelve pages of information on the application, operation, and design of Bristol radiation pryometers has just been published by the Bristol Company, Waterbury 91, Conn.

The principle of operation of the radiation unit is given in considerable detail. Its use with pyrometers of both the potentiometer and millivoltmeter type, with and without control features, is also described; and information regarding ranges, mountings, and accessories is included. Copies will be mailed on request.

Asks Efficient Forest Management

Efficient management of forests and their preservation, as well as an organized program of reforestation is advocated by Dr. Norman McKenzie, who has just arrived in Vancouver to assume his post as president of the University of British Columbia.

Dr. McKenzie stated that the forests of Canada represent one of the most valuable resources of the Dominion and he pointed out that with the minimum of care these forests were constantly reproducing themselves in a way that minerals, for instance, never would. Scientific knowledge suggest, he said, that we are only now beginning to understand how valuable this resource is and how many things we can do with it and make of it.

"I predict that in the not very distant future the bulk of our forest products will be processed and put to a wide variety of uses and the forests will continue to be one of our greatest wealth producers. All of this is, of course, based on the assumption that we have the intelligence to mange and conserve our forests wisely, and the intelligence and industry, too, to preserve them from three great enemies—fire, forest insects and ruthless exploitation."

Powell River Surveys By-Products Field

With a view to the possible establishment of a valuable by-products industry in utilization of sulphite liquor effluent from its pulp and paper plant at the Powell River Company at Powell River, B. C., is undertaking a survey of such potentialities as that particular field offers as part of the Company's postwar development plans.

Dr. M. M. Rosten, who formerly owned and operated the Kutno Chemical Works in Poland, and who recently supervised establishment of an alcohol reduction plant at Thorold for the Ontario Paper Company, has been conducting the survey. Working on the project with Dr. Rosten are M. H. Jones and W. K. Voss, operating officials of the new Thorold plant.

Dr. Rosten declared himself as "favorably impressed" with local possibilities. From a production standpoint he feels certain that Powell River has an abundant supply of the raw material for manufacture of industrial alcohol.

However, marketing possibilities as well as other factors are yet to be thoroughly canvassed.

Almost 200 tons of sulphite pulp are produced daily at Powell River, representing about 50 % recovery from wood, and about 150 tons of lignin are now going to waste. Only the sugar content of this basic material can be effectively used in the manufacture of alcohol.

The set-up would lend itself to the manufacture of several by-products, most important being dry ice or CO_2. It is estimated that four tons of dry ice or 12 tons of CO_2 could be produced daily.

The Thorold alcohol plant has a ready outlet for its production at the synthetic rubber plant of Polymer Corporation, the Canadian government-financed enterprise at Sarnia, Ontario.

No such market exists on the coast at the present time for industrial alcohol although the production of gasoline is one of the interesting possibilities in connection with such an industry in British Columbia.

Ruling on Fiber Boxes

Permission to manufacture certain kinds of solid fiber containers in addition to "V" boxes without specific War Production Board authorization is provided in an amendment to Direction 2 to WPB Order M-290 issued by WPB's Paperboard Division.

Previously the direction forbade the use of solid fiber container production equipment for purposes other than the manufacture of "V" boxes without specific WPB authorization.

Schedule A, now a part of the direction, lists the types of containers, besides "V" boxes, that may be made of solid fiber, with "W" boxes on the same level as "V" boxes.

"V" boxes are water-resistant solid or corrugated fiber shipping containers used extensively for shipping military supplies and materials overseas. "W" boxes are lighter weight boxes made of corrugated fiber board.

Schedule A also includes interior boxes and parts when sold to be packed for the military services in accordance with Army and Navy specifications; solid fiber board sheets to be made into fiber drums; freezer boxes for packing butter, meat and fish, and solid fiber containers for packing military explosives, nitromon, TNT and dynamite.

The amended order also requires certification in order to qualify as preferred orders, except for "V" and "W" box orders. All orders for domestic solid fiber freezer boxes specifying delivery before November 1, placed pursuant to individual directives, must be filled in accordance with such directives. Other orders must comply with the directions as amended, it was pointed out.

To Make Pulp Stones

Preliminary operations on a large new quarry project on Texada Island that will see the establishment of a complete crusher and rolling mill for production of agricultural limestone, flour and pulp stone for use in the production of ground work pulp, are being undertaken by the McMillan Mining and Quarry Company and subsidiary Roche Harbor Lime Company, of Roche Harbor, Wash.

The property recently was purchased by the McMillan interests in a deal involving several thousands of dollars.

Walter S. Planta, pioneer promoter in Texada Island quarrying, was holder of the property which is of virgin rock and located at Eagle Bay.

More than $50,000 will be expended on a wharf, equipment and the installation of machinery.

Preliminary equipment has arrived and 25 men will be employed immediately with this number increased to 100 as the operations expand.

With Reading Multiple Gear Chain Hoists heavy loads can be lifted with little effort. Spur gear design and an 80% efficiency of the hoist gives rapid hoisting with relatively little effort.

Brake action is positive, accurate, easy to control and absolutely safe. The brake itself is self-adjusting and takes up its own wear. Long, trouble-free operation is assured by the self-lubricating gearing sealed in oil; anti-friction bearings sealed against dirt and moisture; and all-steel construction for maximum strength.

Reading Multiple Gear Chain Hoists are available in ratings from ½ ton to 20 tons for hoisting jobs that require speed and accuracy. For full information and prices write for price and dimension data sheet.

READING CHAIN & BLOCK CORPORATION
2113 ADAMS ST., READING, PA.

LIFTED with a 90 lb. PULL

CHAIN HOISTS • ELECTRIC HOISTS • OVERHEAD TRAVELING CRANES

READING HOISTS

American Pioneers

The first oil well near Titusville, Pennsylvania, was drilled by Colonel Edwin L. Drake, and was sixty-nine and one-half feet deep. This was in 1851.

FIVE YEARS after the digging of the first oil well in Pennsylvania, DRAPER BROTHERS commenced operations as woolen manufacturers.

Pennsylvania pioneered in papermaking by the establishment of William Rittenhouse in 1690, as well as in oil-drilling in 1851. Dependent as we are upon oil, we are still more dependent upon paper, and papermaking will always demand the best grades of papermakers' felts — **DRAPER FELTS.**

Draper Felts For Efficiency

DRAPER BROTHERS COMPANY

Woolen Manufacturers Since 1856

CANTON, MASS.

OUR REPRESENTATIVES *to serve you*

L. H. BREYFOGLE, Kalamazoo, Mich.

CHAS. E. BERTSCHY, Milwaukee, Wis.

W. L. CAMPBELL, Savannah, Ga.

RALPH E. BRIGGS, Canton, Mass.

E. R. LELOFF, Vancouver, Wash.

WILLIAM N. CONNOR, Canton, Mass.

Amends Waste Paper Bailing

Twenty-one industrial grades of wastepaper when packed in machine compressed bales may be sold regardless of the weight of the bale at ceilings heretofore applicable only if each bale weighed at least 500 pounds, the Office of Price Administration announced on September 9.

This action, effective September 11, 1944, has been taken at the request of the industry, which has shown that it is customary to pack these grades in bales smaller than 500 pounds. Accordingly, existing ceilings are maintained, with the bale weight requirement eliminated.

The 21 grades affected are: New corrugated cuttings, box board cuttings, white blank news, new manila envelope cuttings, one cut new manila envelope cuttings, manila tabulating cards free from groundwood, manila tabulating cards groundwood, No. 1 hard white shavings, hard white envelope cuttings, one cut hard white envelope cuttings, No. 1 soft white shavings, one cut soft white shavings, miscellaneous soft white shavings, No. 1 fly leaf shavings, No. 1 groundwood fly leaf shavings, No. 2 mixed colored groundwood shavings, No. 1 assorted kraft (old kraft), triple sorted No. 1 brown soft kraft, mixed kraft envelope and/or bag cuttings, kraft envelope cuttings, and new 100% kraft corrugated cuttings.

The 500-pound baling provision on the ten other grades of wastepaper continues in effect, industry concurring that there should be no change in this requirement on these grades. Another change made today results in an increase of $3 per ton in the ceiling price of mixed books when sold as wastepaper for use in the manufacture of paperboard. A former provision has been eliminated, which required that mixed books must take the ceiling price of No. 1 mixed paper when sold to paperpoard manufacturers. Ceilings on mixed books are $17 per ton when sold loose and $22 per ton when sold in 500-pound bales. Ceilings on No. 1 mixed paper are $14 per ton when sold loose and $19 per ton when sold in 500-pound bales. This action has been taken to eliminate the discouragement of shipments of mixed books to paperboard manufacturers because of the price ceiling. Since the function of allocation properly falls within the jurisdiction of the War Production Board, OPA said that it had determined such matters should be left to that agency.

LONGER LIFE
For Equipment!

Cut Maintenance Costs—Use Industrial Chromium Plating

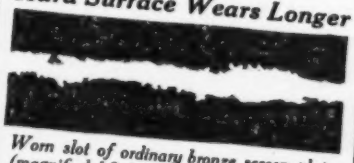
CRODON's exceptionally efficient protection against wear and corrosion insures substantial savings in your maintenance costs. Because chromium is the hardest commercial metal and completely non-corrosive, CRODON-plating prolongs the normal life of your equipment and reduces expenses incurred by frequent replacements, operating delays and interrupted production.

CRODON-plated equipment also insures better-quality products. More precise, better-defined results and more perfect finish are obtainable, due to CRODON-plating's unusually smooth, hard, easily cleaned surface. It also offers remarkable freedom from product contamination. Its new-equipment performance endures for surprisingly long periods.

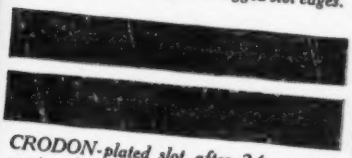
Look for the trademark CRODON — it assures you of the best in chromium plate. It guarantees top quality applied in the most practical, economical way — for behind every CRODON application are the expert knowledge, experience and resources of America's largest and oldest industrial chromium plating organization.

Let us show how CRODON-plating can help you solve your maintenance and cost problems.

Hard Surface Wears Longer

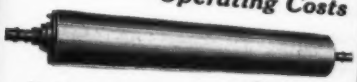


Worn slot of ordinary bronze screen plate (magnified 10 diameters) after 10 months' service, showing rough and ragged slot edges.



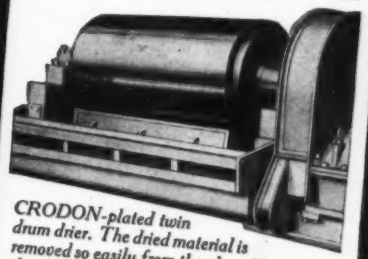
CRODON-plated slot after 24 months' service. Note permanent slot accuracy, absence of wear and smoothness of slot edges.

Corrosion Resistance Cuts Operating Costs



Steel couch roll, 116 inches long — 20 inches diameter, CRODON-plated to resist corrosion.

Smoothness Insures Better Quality Product



CRODON-plated twin drum drier. The dried material is removed so easily from the glass-like surface that power consumption is greatly reduced and scraper knives last many times longer.

CRODON PLATING pays

CHROMIUM PLATING

CHROMIUM CORPORATION OF AMERICA

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346 Huntingdon Avenue, Waterbury, Conn. | 1760 Lakeview Road, Cleveland, Ohio | 4645 West Chicago Avenue, Chicago, Ill.

New York Paper and Pulp Market Review

Paper Supply Situation Expected To Continue Tight Until End of European War—Sweden Reported Prepared To Supply American Pulp Needs—OPA Amends Bale Weight Ruling On Waste Paper.

Office of the PAPER TRADE JOURNAL,
Wednesday, September 13, 1944.

Paper supply for civilian consumption continues substantially under requirements. No relief from this tight supply situation appears possible until the European war ends. Government estimates of essential requirements for all purposes continue very high. The Army reports urgent need for more book, writing and groundwood papers. The supply situation in paper board is more critical than in paper and the future supply situation is entirely contingent upon the conclusion of the conflict in Europe. Paper production is sufficiently high to supply trade needs but war demands have been higher than had been estimated earlier in the year.

Newsprint consumption quotas of 30-pound newsprint paper have been reduced to newspaper publishers, effective October 1, 1944. The quarterly consumption by special types of newspapers and newspapers using less than 25 tons quarterly, will be frozen at the average quarterly consumption in the first three quarters of 1944, or the consumption in the corresponding calendar quarter, whichever is greater. Additional tonnage for printing newspapers for sale to the armed services personnel has also been pegged.

Paper production for the week ended September 9 was estimated at 92.8%, compared with 90.7% for 1943, with 83.3% for 1942, with 84.8% for 1941, and with 69.3% for the corresponding week for 1940.

Paper board production for the week ended September 9 was 97.0%, compared with 97.0% for 1943, with 78.0% for 1942, with 80.0% for 1941, and with 60.0% for the corresponding week for 1940.

Wood Pulp

With the rapid progress of the allied forces raising the expectation that the end of the war in Europe will come relatively soon, interest is revived in the position of Scandinavian countries supplying wood pulp. Chemical pulp inventories in Sweden at the present time are reported between 600,000 and 700,000 tons, with capacity close to 250,000 tons a month. Although the British contract is for monthly shipments over a year aggregating 20,000 tons monthly, J. A. Pagel, president of the Association of American Wood Pulp Importers, declares Swedish capacity should be adequate to meet American needs.

Rags

Mill demand for the paper making grades of new cotton rags is active. Mills producing writings and bonds are reported purchasing in volume.

Roofing mills are also reported showing keen interest in low grade cuttings. Fiber, plastic and other consumers are also actively in the market. The heavy demand for roofing rags continues at this date, with the major requests for old whites. Demand for third and blues is reported only fair.

Old Rope and Bagging

Demand for old rope continues active. No important change in the market situation has been reported at this date. Prices are well maintained by relative light current supplies.

The scrap bagging market continues to reflect more strength. Inquiries from consumers are increasing but the price factor still keeps trading slow. Prices continue unchanged.

Old Waste Paper

The expected OPA Amendment No. 9 to MPR No. 30, changing the ruling of weight of bales, was issued on September 9. It states that 21 grades of paper stock, when purchased in machine compressed bales, may be sold regardless of the weight of the bales, at ceilings heretofore applicable only if each bale weighed at least 500 pounds. Amendment No. 9 became effective on September 11, 1944.

The WPB has issued appeals for the collection of more waste paper from business concerns and all other sources. More tonnage is needed by the mills, particularly for the production of paper board, to meet the extremely and apparently increasing demands of the government. Prices are firm at ceilings.

Twine

Demand for twine continues active. No change of importance in supply, demand, or prices, has been reported this week. Fibers continue in active demand by paper, plastics and other consumers.

Quaker Oats Organizes Chemicals Dept.

The Quaker Oats Company, sole producer of furfural and allied chemicals for many years, announces the formation of a Chemicals Department, August 1, 1944. This step is expected not only to facilitate continued handling of war orders, but to develop an improved organization with which to enter the post-war period. This department will integrate the functions of sales, research, and production heretofore carried out by several divisions of the company. The furfural and technical divisions become merged in the chemicals department under the new plan, and their former designations discontinued.

The Quaker Oats Company at the same time announces the appointment of Dr. Lauren B. Hitchcock as manager of the chemicals department, located at the general offices, 1900 Board of Trade Building, Chicago 4, Ill. For the past nine years he has been with the Hooker Electrochemical Company, Niagara Falls, N. Y., in both research and sales Departments, lately as manager of sales development. Formerly Professor of Chemical Engineering at the University of Virginia, he received his training at the Massachusetts Institute of Technology.

Philip Richardson Made Director

[FROM OUR REGULAR CORRESPONDENT]

BOSTON, Mass., September 11, 1944—At a recent meeting of the stockholders of Storrs & Bement Company, Philipp Richardson was elected a director. Mr. Richardson has been with the company 20 years, in charge of the Linweave Department, and has supervision of the firm's warehousing facilities.

IN harvesting our timber crop, we are finding as a nation that our forest land is a tremendous victory garden. • Its fruits include staples like rough and finished lumber . . . like a hundred kinds of paper to promote and sustain the vitality of enterprises military and civilian. • And the forest yields an endless variety of essential products like fabrics, special packages, plastics . . . even gunpowder. • It is fortunate for this country and its allies that vast forests like those of the Pacific Northwest are yielding an abundant and continuous supply of things needed at home and abroad by men at war.

Pulp Division
Weyerhaeuser Timber Company

BLEACHED AND UNBLEACHED SULPHITE PULP
Mills at Longview, Washington • Everett, Washington

MISCELLANEOUS MARKETS

Office of the PAPER TRADE JOURNAL,
Wednesday, September 13, 1944.

BLANC FIXE—The market for blanc fixe continues to conform to prevailing quotations. Current demand fair. The pulp is currently quoted at $40 per ton, in barrels, at works; the powder is currently quoted at $60 per ton.

BLEACHING POWDER—Current demand is reported active. Supply situation reported satisfactory. Bleaching powder is currently quoted at from $2.50 to $3.10 per 100 pounds. All prices in car lots, in drums, f.o.b. works.

CASEIN—OPA maximum prices on processed acid-precipitated casein are as follows: 10,000 pounds or more, 25 cents per pound; 2,000 pounds, 24½ cents per pound; less than 2,000 pounds, 24¾ cents per pound, f.o.b. shipping point.

CAUSTIC SODA—Supply situation continues tight, with production and demand reported very heavy. Solid caustic soda is currently quoted at $2.30 per 100 pounds. The flake and ground are currently quoted at $2.70 per 100 pounds All prices in car lots, in drums, f.o.b. works.

CHINA CLAY—Demand for some grades of china clay is reported moderate this week. Domestic filler clay is currently quoted at from $7.50 to 15 per ton; coating clay is quoted at from $12 to $22 per ton, at mines. Imported china clay is currently quoted at from $13 to $25 per long ton, ship side.

CHLORINE—Production reported excellent. Demand for all uses heavy; most essential requirements fulfilled. Prices remain unchanged. Chlorine is quoted at $1.75 per 100 pounds, in single-unit tank cars, f.o.b. works.

ROSIN—Higher prices are quoted on some grades of rosin this week: OPA ceiling price on "G" gum rosin is set at $5.33 per 100 pounds, in barrels, Savannah. "FF" wood rosin is currently quoted at $5.32 per 100 pounds in barrels, New York. Seventy per cent gum rosin is currently offered at $5.60 per 100 pounds, f.o.b. works.

SALT CAKE—Demand reported moderate. Quotations on salt cake continue to remain unchanged. Domestic salt cake is currently quoted at $15 per ton; chrome cake at $16 per ton. All prices, car lots, at shipping point.

SODA ASH—Market requirements for soda ash continue very heavy. Production reported good but demand is reported in excess of supply. Prices continue unchanged. Prices on soda ash in car lots, per 100 pounds, are as follows: in bulk, $.90; in paper bags, $1.05; and in barrels, $1.35.

STARCH—Corn is reported coming into market in larger volume, and industrial supply situation appears improved. Quotations continue unchanged. Pearl is currently quoted at $3.72 per 100 pounds. The powdered grade is currently quoted at $3.83 per 100 pounds. All prices f.o.b. Chicago.

SULPHITE OF ALUMINA—Supply situation is well balanced. Quotations are unchanged. Prices on the commercial grades are quoted at from $1.15 to $1.25 per 100 pounds. The iron free is currently quoted at $2.35 per 100 pounds. All prices in car lots, in bags, f.o.b. works.

SULPHUR—Demand is reported steady for sulphur. Quotations on all grades continue unchanged. Annual contracts are currently quoted at $16 per long ton, f.o.b. mines. The current contract prices at Gulf Ports remains unchanged at $17.50 per long ton.

TALC—The market for domestic talc is reported moderately active. Quotations unchanged. Domestic grades are quoted at from $16 to $21 per ton, at mines.

MARKET QUOTATIONS

All market quotations, excepting those otherwise designated as official OPA maximum prices, are based on the manufacturers' price level as of October 1-15, 1941; maximum wholesale prices are based on the merchants' maximum prices for stipulated quantities at a quoted price to all customers of a like class, as shown by the merchant's sales records of goods delivered during March, 1942. A merchant's price list in effect in March 1942, showing quotations of actual shipments, will establish the current maximum prices.

Paper

(Delivered New York)

Standard News, per ton—			
Roll, contract...	*$58.00	@	—
Sheets	66.00	"	—
* OPA Maximum Price.			
Kraft—per cwt.—Carload Quantities Zone A, f.o.b. Mill			
Superstandard Wrapping	*$5.25	@	—
No. 1 Wrapping...	*5.00	"	—
Standard Wrapping	*4.75	"	—
Standard Bag.....	*4.375	"	—
* OPA Manufacturers' Prices.			
Tissues—Per Ream—Carlots			
White No. 1.....	1.12½	"	—
White No. 1 M. G.	1.10	"	—
White No. 1¼....	1.00	"	—
White No. 2.....	.90	"	—
Anti-Tarnish M.F..	1.20	"	—
Colored	—	"	—
Kraft	.95	"	—
Manila	.90	"	—
Toilet—1 M. Sheets—Per Case			
Unbleached	4.25	"	—
Bleached	5.70	"	—
Unbl. Toilet, 1 M.	4.16	"	—
Bleached Toilet....	5.70	"	—
Paper Towels, Per Case—			
Unbleached, Jr.....	2.20	"	—
Bleached, Jr.	3.20	"	—
Manila—per cwt.—C. l. f. a.			
No. 1 Jute.....11.25		@	—
No. 1 Manila Wrapping, 35 lb....	6.00	"	6.25
No. 2 Manila Wrapping, 35 lb.....	5.75	"	6.00
Boards, per ton—			
News *48.00		@	—
Chip *48.00		"	—
Sgl. Mla. L1. Chip*	60.00	"	—
White Pat. Coated*	75.00	"	—
Kraft Liners 50 lb.*	63.00	"	—
Binders Boards...	84.00	"	116.00

* OPA Base Prices per 10 tons. Less than 10 tons but over 3 tons, add $2.50; three tons or less, add $5; regular 35-39 basis, add $5.; basis 40-49, add $2.50; basis 91-100, add $2.50; basis 101-120, add $5.

The following are representative of distributors' resale prices:

Rag Content Bonds and Ledgers—White, Assorted Items, Delivered in Zone 1:

	Bonds		Ledgers	
100% Rag Ext. No. 1	$39.10	@$46.00	$40.25	@$47.25
100% Rag	32.20 "	37.75	33.35 "	39.25
85% Rag	.... "	....	29.90 "	35.00
75% Rag	23.00 "	27.00	24.15 "	28.25
65% Rag	.... "	....	22.80 "	27.75
50% Rag	18.70 "	22.75	19.90 "	24.25
25% Rag	16.40 "	20.00	17.55 "	21.50

Colors at $1.00 cwt. extra.

Sulphite Bonds and Ledgers—White, Assorted Items. Delivered in Zone 1:

	Bonds		Ledgers	
No. 1..	$10.55	@$12.75	$11.70	@$14.25
No. 2..	9.65 "	11.75	10.80 "	13.25
No. 3..	9.20 "	11.25	10.35 "	12.50
No. 4..	8.90 "	10.75	10.05 "	12.25

Colors $1.00 cwt. extra.

Free Sheet Book Papers—White, Cased Paper. Delivered in Zone 1:

No. 1 Glossy Coated...	$13.65	@	$15.50
No. 2 Glossy Coated...	12.40	"	14.00
No. 3 Glossy Coated...	11.60	"	13.25
No. 4 Glossy Coated...	11.15	"	12.75
No. 1 Antique (watermarked)	10.25	"	11.75
No. 2 Offset	9.60	"	11.00
A Grade E. F.....	9.35	"	10.75
A Grade S. & S. C...	9.60	"	11.00
B Grade E. F.	8.85	"	10.25
B Grade S. C.	9.10	"	10.50
C Grade E. F.	8.55	"	9.75
C Grade S. C.	8.80	"	10.00
D Grade E. F.	8.25	"	9.50
D Grade S. & S. C. ..	8.50	"	9.75

Ivory & India at $.50 cwt. extra.

Wood Pulp

OPA Maximum Prices and Canadian Manufacturers Prices, Less Freight Not Exceeding OPA Allowances.

Bl. Softwood Sulphite.....	$86.00
Unbl. Softwood Sulphite.....	74.00
Bl. Hardwood Sulphite.....	83.50
Unbl. Hardwood Sulphite.....	71.50
Bl. Mitscherlich	81.00
Unbl. Mitscherlich ..72.00 @	82.00
N. Bleached Sulphate	86.00
S. Bleached Sulphate	79.00
N. Semi-Bleached Sulphate...	82.00
S. Semi Bleached Sulphate...	75.00
N. Unbl. Sulphate.....	73.00
S. Unbl. Sulphate	63.50
Bl. Soda	72.00
Unbl. Soda	68.00
Groundwood	50.00

Transportation Allowances

Applying to Producers of Wet Wood Pulp.

	Below 50% Air Dry Weight	50%-80% Air Dry Weight
Northeast	$13.50	11.50
Lake Central	13.50	11.50
Southern	16.00	14.00
West Coast (in area).....	10.50	9.50
West Coast (out area).....	16.50	15.50

Applying to Producers of Dry Wood Pulp.

	Above 80% Air Dry Weight
Northeast	$8.50
Lake Central	8.50
Southern	11.00
West Coast (in area)	7.50
West Coast (out area)	13.50

Should freight charges actually exceed these allowances, the difference may be added to the maximum prices.

Domestic Rags

New Rags

(Prices to Mill f. o. b. N. Y.)

Shirt Cuttings—			
New White, No. 1..	6.50	@	7.25*
Silesias No. 1.....	—	"	5.75*
New Unbleached...	6.75	"	7.50*
Blue Overall	—	"	5.50*
Fancy	—	"	3.50*
Washables	—	"	3.00*
Bleached Khaki Cuttings	—	"	4.25*
Unbleached Khaki Cuttings	—	"	3.50*

* OPA Maximum Prices.

If humid conditions
LOWER BELT EFFICIENCY
SHORTEN BELT LIFE
. . . get the solution
through . . .

Rhoads Engineering Service

Rhoads Engineering Service has shown many paper mills how the application of Tannate Watershed Leather Belting can result in more efficient drives, requiring less maintenance. Tannate is an ideal belt for paper mill service where a hot, humid atmosphere may exist. It is made with waterproof cement, and treated to resist moisture so that even when damp it will carry nearly a full load without laps or plies separating.

Tannate is strong, flexible, and enduring. Let us tell you what it has done for other mills and what it can do for you.

Rhoads Tannate WATERSHED LEATHER BELTING

J. E. RHOADS & SONS • Est. 1702
35 N. SIXTH ST., PHILA. 6, PA.
NEW YORK · CHICAGO · ATLANTA · CLEVELAND

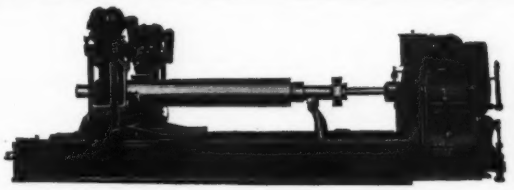
In Prosperity or Depression ...During War or Peace

The Lobdell Company had its beginnings only sixty years after the United States was established as a Nation. Under free enterprise, trackless forests and almost endless grassy plains, trod by the feet of the pioneer, became dotted with farms and settlements.

Villages grew into cities, cross-road stores became great mercantile establishments, small shops developed into mighty industries.

The Lobdell Company has been part and parcel of this growth. When peace returns and war-time restrictions are lifted, industry will resume normal production . . . will help build a greater America. Having learned valuable lessons from the blunders of the recent past, the Nation looks with confidence to the future.

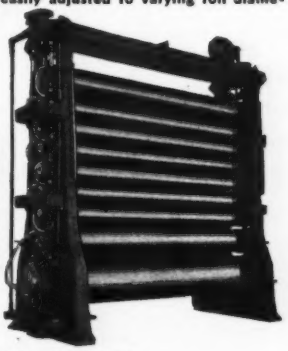
Lobdell leadership can be counted upon to support and encourage competitive, private enterprise . . . the best guarantee of quality and economy production of all consumer goods, including the up-to-date line of Lobdell machinery for the paper and allied industries.



ROLL GRINDERS:
The automatic crowning device, a feature of all Lobdell Roll Grinders, grinds a perfect crown of any size, on any length roll. Roll Grinders are now completely automatic due to the new automatic grinding wheel in-feed. The need for continual attention by the operator is entirely eliminated. A constant and uniform grinding pressure is maintained . . . wheel wear is reduced and the grinding operation is speeded up. The automatic in-feed attachment can be installed on any Lobdell roll grinding machine, now equipped with the Lobdell crowning device.

MICROMETER ROLL CALIPERS:
Indispensable in keeping check on regrinding of rolls. Extremely accurate, light in weight and easily adjusted to varying roll diameter; 7" to 30", 8" to 36" and 9" to 42".

CALENDER STACKS:
Lobdell Calender stacks are accurate, durable and easily operated. Roll lifts, controlled from the floor, may be actuated by electric motor, hydraulic power or hand ratchet. Up-to-the-minute automatic lubrication or anti-friction bearing equipment is employed as service indicates.



PURALOY CHILLED CALENDER ROLLS:
Made of an exclusive Lobdell developed alloy, having hardness and corrosion resistance to meet the added severe service of water finish, etc. Alloys used in "Puraloy" rolls are under wartime regulation. Now available in limited quantities.

We are interested in your post-war needs . . . and urge you to call upon us for information and consultation. A post card brings the new catalog of Lobdell machinery for the paper making and allied industries.

LOBDELL
COMPANY ESTAB. 1836 WILMINGTON 99, DEL.
Built and sustained upon the rights to Free, Competitive, Private Enterprise guaranteed by the Constitution of the United States
Rolls • Calender Stacks • Roll Calipers • New Improved Roll Grinding Machines

Old Rags

White, No. 1—
- Repacked *3.80
- Miscellaneous *3.20

White, No. 2—
- Repacked *2.90
- Miscellaneous *2.65

Third and Blues—
- Repacked *2.20
- Miscellaneous *1.80

Roofing Rags—
- No. 1 ..... *1.55
- No. 2 ..... *1.45
- No. 3 (bagging).. *1.35
- No. 4 ..... *1.35
- No. 5A *1.35
- Old Manila Rope.. 5.75

*OPA Maximum Prices.

Foreign Rags

All Prices nominal

New Rags

New Dark Cuttings..	2.25	●	2.40
New Mixed Cuttings.	2.00	"	2.20
New Light Silesias..	5.50	"	5.75
Light Flannelettes...	5.50	"	5.75
New White Cuttings.	7.00	"	7.50
New Light Oxfords.	4.00	"	4.50
New Light Prints...	3.00	"	3.25

Old Rags

No. 1 White Linens.	7.50	"	8.50
No. 2 White Linens.	6.50	"	7.50
No. 3 White Linens.	4.50	"	—
No. 4 White Linens.	2.25	"	3.25
No. 1 White Cotton.	4.25	"	4.75
No. 2 White Cotton.	3.25	"	3.75
No. 3 White Cotton.	2.50	"	3.00
No. 4 White Cotton.	1.90	"	2.20
Extra Light Prints..	2.00	"	2.40
Ord. Light Prints...	1.75	"	2.15
Med. Light Prints...	1.55	"	1.95
Dutch Blue Cottons.	2.25	"	2.50
French Blue Linens.	3.00	"	—
Checks and Blues...	2.00	"	—
Linsey Garments....	1.90	"	2.00
Dark Cottons.....	1.50	"	1.60
Old Shopperies.....	1.30	"	1.45
New Shopperies.....	1.45	"	1.50
French Blues.....	2.25	"	2.50

BAGGING

(Prices to Mill, f. o. b. N. Y.)

Gunny No. 1—			
Foreign .....Nominal			
Domestic	4.25	●	4.35
Wool Tares, light....	4.25	"	4.50
Wool Tares heavy...	4.50	"	5.00
Bright Bagging.....	4.50	"	4.85
Manila Rope—			
Foreign	—	"	—
Domestic	*5.75	"	—
Jute Threads.....	5.50	"	—
No. 1 Sisal Strings..	*4.00	"	—
Mixed Strings.....	2.00	"	—

*OPA Maximum Price.

Old Waste Papers

(F. o. b. New York)

OPA Maximum Prices, Baled

No. 1 Hard White Envelope Cuts, one cut	3.37½	●	—
No. 1 Hard White Envelope Cuts....	3.12½	"	—
No. 1 Hard White Shavings, unruled.	2.87½	"	—
No. 1 Hard White Shavings, ruled...	2.50	"	—
Soft White Shavings, one cut.....	2.87½	"	—
No. 1 Soft White Shavings	2.50	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 Fly Leaf Shavings	1.67½	"	—
No. 2 Fly Leaf Shavings	1.12½	"	—
No. 1 Groundwood Fly Leaf Shavings	1.25	"	—
No. 2 Mixed Groundwood Fly Leaf Shavings	.90	"	—
Mixed Colored Shavings	.75	"	—
Mixed Groundwood Colored Shavings..	.90	"	—
Overissue Magazines	1.67½	"	—
No. 1 Heavy Books & Magazines	1.92½	"	—
Mixed Books.....	1.10	"	—
No. 1 White Ledger..	2.30	"	—
No. 2 Mixed Ledger, colored	2.00	"	—
New Manila Envelope Cuttings, one cut..	2.87½	"	—
New Manila Envelope Cuttings	2.65	"	—
Extra Manilas.....	1.95	"	—
Mixed Kraft, Env. & Bag Cuttings.....	2.75	"	—
Kraft Envelope Cuttings	3.25	"	—
Triple Sorted, No. 1 Brown Soft Kraft.	2.50	"	—
New 100% Kraft Corrugated Cuttings..	2.25	"	—
No. 1 Assorted Old Kraft	1.75	"	—
New Jute Corrugated Cuttings	.90	"	—
Old 100% Kraft Corrugated Containers	1.75	"	—
Old Corrugated Containers	1.40	"	—
Box Board Cuttings.	.72½	"	—
White Blank News..	1.65	"	—
Overissue News.....	1.10	"	—
No. 1 News.....	1.00	"	—
No. 1 Mixed Paper...	.95	"	—
Old Corrugated Containers	.82½	"	—
Mill Wrappers.....	1.10	"	—

Twines

All Prices Nominal

(F. o. b. Mill)

(Soft Fiber)

Coarse Polished—			
India	.21	●	—
White Hemp.....	.21	"	—
Fine Polished—			
Fine India.....	.26	"	—
Unpolished—			
Box	.17¾	"	—
Paper Makers.....	.17	"	—
Tube Rope.....	.19	"	—
Wall Paper.....	.20½	"	—
Wrapping	.23	"	—
Soft Fiber Rope...	.19	"	—
Cotton	.25	"	—

(Hard Fiber)

Medium Java.....	.18	"	—
Mex. Sisal.....	.16	"	—
Manila	—	"	—

PHILADELPHIA

Domestic Rags (New)

(Price to Mill.)

Shirt Cuttings—	
New White No. 1.....	.07¼
New White No. 2.....	.05¾
Light Silesias.....	.05¾
Black Silesias, soft.....	.03¾
New Unbleached	.07½
Washable Prints	.04¼
Washable No. 1.....	.03
Blue Overall.....	.05½
Cottons—According to grades—	
Washable shredding	.01¾
Fancy Percales	.04¾
New Black Soft	.03¼
Khaki Cuttings—	
Unbleachable Cotton Cuttings	.03½
Bleachable Cotton Cuttings..	.04¼
Men's Corduroy	.03½
Ladies' Corduroy	.03
Cottonades	.03¼

Domestic Rags (Old)

White No. 1—Repacked	3.80	"	—
Miscellaneous No. 1.	3.20	"	—
Miscellaneous No. 2.	2.65	"	—
White No. 2—Repacked	2.90	"	—
Thirds and Blues—			
Miscellaneous	1.80	"	—
Repacked	2.20	"	—
Black Stockings—			
(Export) .....Nominal			
Roofing Stock—			
Foreign No. 1....Nominal			
Domestic No. 1...	1.55	"	—
Domestic No. 2...	1.45	"	—
Roofing Bagging..	1.35	"	—
Old Manila Rope...	5.75	"	—

Bagging

(F. o. b. Phila.)

Gunny No. 1—			
Foreign .....Nominal			
Domestic	3.00	"	3.50
No. 1 Clean bright—			
Sisal Strings			.04
No. 2 Clean bright—			
Sisal Strings			.03
Sisal Jute	.02½	"	.02¾
Scrap—			
No. 1.....	3.25	"	3.50
No. 2.....	1.75	"	1.80
Wool Tares	4.00	"	4.25
No. 1 New Light Burlap	3.00	"	4.00
New Burlap Cuttings	3.75	"	4.00

Old Papers

(F. o. b. Phila)

OPA Maximum Prices, Baled

No. 1 Hard White Envelope Cuts, one cut	3.37½	"	—
No. 1 Hard White Shavings, unruled..	2.87½	"	—
Soft White Shavings, one cut.....	2.50	"	—
White Blank News..	1.65	"	—
Soft White Shavings, Misc.	1.25	"	—
No. 1 Hard White Shavings, ruled...	2.50	"	—
Soft White Shavings, one cut.....	2.87½	"	—
No. 1 Soft White Shavings	2.50	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 Fly Leaf Shavings	1.67½	"	—
No. 2 Fly Leaf Shavings	1.12½	"	—
No. 1 Groundwood Fly Leaf Shavings	1.25	"	—
No. 2 Mixed Groundwood Fly Leaf Shavings	.90	"	—
Mixed Colored Shavings	.75	"	—
Mixed Groundwood Colored Shavings..	.90	"	—
Overissue Magazines	1.67½	"	—
No. 1 Heavy Books & Magazines	1.92½	"	—
Mixed Books.....	1.10	"	—
No. 1 White Ledger..	2.30	"	—
No. 2 Mixed Ledger, colored	2.00	"	—
New Manila Envelope Cuttings, one cut..	2.87½	"	—
New Manila Envelope Cuttings	2.65	"	—
Extra Manilas.....	1.95	"	—
Mixed Kraft, Env. & Bag Cuttings.....	2.75	"	—
Kraft Envelope Cuttings	3.25	"	—
Triple Sorted, No. 1 Brown Soft Kraft.	2.50	"	—
New 100% Kraft Corrugated Cuttings..	2.25	"	—
No. 1 Assorted Old Kraft	1.75	"	—
New Jute Corrugated Cuttings	.90	"	—
Old 100% Kraft Corrugated Containers	1.75	"	—
Old Corrugated Containers	1.40	"	—
Box Board Cuttings.	.72½	"	—
White Blank News..	1.65	"	—
Overissue News.....	1.10	"	—
No. 1 News.....	1.00	"	—
No. 1 Mixed Paper...	.95	"	—
Old Corrugated Containers	.82½	"	—
Mill Wrappers.....	1.10	"	—

BOSTON

Old Papers

(F. o. b. Boston)

OPA Maximum Prices, Baled

No. 1 Hard White Shavings, unruled.	2.87½	●	—
No. 1 Hard White Shavings, ruled...	2.50	"	—
Soft White Shavings, Misc.	2.15	"	—
No. 1 Fly Leaf Shavings	1.67½	"	—
No. 2 Fly Leaf Shavings	1.12½	"	—
No. 1 Groundwood Fly Leaf Shavings	1.25	"	—
No. 2 Groundwood Fly Leaf Shavings	.90	"	—
Mixed Colored Shavings	.75	"	—
New Manila Envelope Cuts, one cut.....	2.87½	"	—
Hard White Envelope Cuts, one cut.....	3.37½	"	—
Triple Sorted No. 1 Brown Soft Kraft.	2.50	"	—
Mixed Kraft Env. & Bag Cuttings.....	2.75	"	—
Kraft Envelope Cuttings	3.25	"	—
No. 1 Heavy Books & Magazines.....	1.92½	"	—
New Manila Envelope Cuts, one cut.....	2.87½	"	—
New Manila Envelope Cuttings	2.65	"	—
White and Colored Tabulating Cards..	2.25	"	—
Ground Wood Tabulating Cards	1.35	"	—
White Blank News..	1.65	"	—
No. 1 Assorted Old Kraft	1.75	"	—
No. 1 Mixed Paper...	.95	"	—
Overissue News.....	1.10	"	—
Box Board Cuttings.	.72½	"	—
New Corrugated Cuttings, Kraft.....	2.25	"	—
Old 100% Kraft Corrugated Containers	1.75	"	—
Old Corrugated Containers	1.40	"	—
Jute Corrugated Cuttings	1.07½	"	—

Bagging

(F. o. b. Boston)

Gunny Bagging—			
Foreign .....(nominal)			
Domestic	—	@	2.75
Sisal Rope No. 1....	*4.75	"	—
Sisal Rope No. 2....	*4.25	"	—
Mixed Rope	—	"	1.55
Transmission Rope—			
Foreign .....(nominal)			
Domestic	2.75	"	3.00
Manila Rope—			
Foreign .....(nominal)			
Domestic	5.75	"	—
Soft Jute Rope.....	5.25	"	—
Jute Car Threads.	3.00	"	3.50
Bleachery Burlap....	8.50	"	9.00
Scrap Burlap—			
Foreign .....(nominal)			
Domestic	—	"	2.50
South American ...	—	"	3.00
Wool Tares—			
Foreign .....(nominal)			
Domestic	4.25	"	—
Aust. Wool Pouches..	—	"	3.25
New Zealand Wool Pouches	—	"	3.50
New Burlap Cuttings	4.75	"	5.00
Heavy Baling Bagging	4.00	"	4.25
Paper Mill Bagging..	2.50	"	3.00
No. 2 Roofing Bagging	1.35	"	—

*OPA Maximum Price.

Domestic Rags (New)

(F. o. b. Boston)

Shirt Cuttings—			
New Light Prints.	.04½	●	.04¾
Fancy Percales....	.04¼	"	.01
New White No 1.	.06¾	"	.07
New Light Flannelettes	.05½	"	.06
Canton Flannels, Bleached	.06	"	.06½
Underwear Cutters, Bleached	.06¼	"	06½
Underwear Cutters, Unbleached	.05¼	"	.06
Silesias No. 1.....	.06	"	.06½
New Black Silesias..	.03	"	.03½
Red Cotton Cuttings	.03½	"	.04
Soft Unbleached ...	.06½	"	.06¾
Blue Cheviots	.05½	"	.06
Fancy	.02¾	"	—
Washable	.02¾	"	—
Khaki Cuttings	02¾	"	.03
O. D. Khaki.....	.03½	"	.03¾
Corduroy	.03¼	"	.03½
New Canvas	.06¼	"	.06¾
B. V. D. Cuttings...	.06¼	"	.06¾

Domestic Rags (Old)

(F. o. b. Boston)

White No. 1—			
Repacked	3.80	●	—*
Miscellaneous	3.20	"	—*
White No. 2—			
Miscellaneous	2.65	"	—*
Twos and Blues, Repacked	2.20	"	—*
Old Blue Overalls...	2.25	"	2.30
Thirds and Blues, Repacked	2.20	"	—*
Miscellaneous	1.80	"	—*
Black Stockings	3.50	"	4.00
Roofing Stock—			
No. 1	1.55	"	—*
No. 2	1.45	"	—*
No. 3	1.35	"	—*
No. 4	1.35	"	—*
No. 5, Quality A..	1.35	"	—*
Quality B..	1.20	"	—*
Quality C..	.95	"	—*
Old Manila Rope..	5.75	"	—

*OPA Maximum Prices.

Foreign Rags

(F. o. b Boston)

Canvas	(nominal)
Dark Cottons	(nominal)
Dutch Blues	(nominal)
New Checks and Blues..	(nominal)
Old Fustians	(nominal)
Old Linsey Garments....	(nominal)
New Silesias	(nominal)

CHICAGO

Waste Paper

(F. o. b. Chicago)

OPA Maximum Prices, Baled

Shavings—			
No. 1 Hard White Envelope Cuts, one cut	3.37½	"	—
No. 1 Hard White Shavings, unruled.	2.87½	"	—
No. 1 Soft White Shavings	2.50	"	—
No. 1 White Ledger..	2.30	"	—
No. 1 Heavy Books & Magazines.....	1.92½	"	—
White Blank News..	1.65	"	—
Mixed Kraft Env. & Bag Cuttings...	2.75	"	—
No. 1 Assorted Old Kraft	1.75	"	—
Overissue News.....	1.10	"	—
No. 1 News.....	1.00	"	—
No. 1 Mixed Paper...	.95	"	—
No. 1 Roofing Rags.	1.55	"	—
No. 1 Roofing Bags.	1.45	"	—